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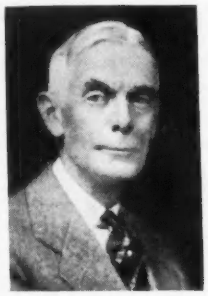
Probabilities in Automobile Design



Henry M. Crane

Flashes—***Next year—increases in power, economy and reliability of operation of powerplants. Bigger crankshafts for smaller cars—No change from present conventional engine types . . . More use of overdrive—perhaps with manual shift . . . No further great change in front-ends . . . Generators going to be bigger . . . Streamlining for advertising purposes . . . Brakes can be bettered.***

By Henry M. Crane

Technical Assistant to the President, General Motors Corp.

MY subject, "Recent Trends in Passenger-Car Design," covers a very large amount of ground. I shall attempt to cover that ground as well as possible in a reasonable space. The best way will be to discuss the motor car more or less piecemeal, and perhaps then finally the motor car as a whole.

Powerplants

We may well begin with the powerplant. Next year unquestionably will see a continuation of the increase in powerplant efficiency, both in available power and in economy and reliability of operation. There are many mechanical reasons for this, and one other reason which I think is a very great credit to the engineers of the Society, and that is the fuel. I don't know how many of you realize that today the so-called standard grades of gasoline in New York are as good as the premium grades of gasoline of four or five years ago, and infinitely better than any gasoline of 15 years ago.

More than 15 years ago, the Society was addressed at Ottawa Beach by a representative of the American Petroleum Institute. From that meeting came the idea that it would be of great advantage to the automotive as well as to the oil industry to have some cooperative meetings between the engineers of the two industries.

This idea was brought to a focus through the assistance of the Bureau of Standards in Washington and a meeting was held there to canvass the possibilities. As a result, the Cooperative Fuel Research Committee was organized, with the support of the engineers of both industries and, more important than that, the support of the American Petroleum Institute, and the National Automobile Chamber of Commerce.

I call attention to this because it is an outstanding example of cooperative engineering action, and has done more than any one thing to improve greatly, not only the availability of fuel for our motor cars, but also the design of the motor cars so as better to make use of the fuel available. That work is still going on, and, I think, should go on indefinitely, because it is of outstanding benefit.

Two important elements in the fuel have contributed to our ability to increase engine efficiency. One of these is antiknock value; the other, general control of fuel as to volatility. It is astounding to read in the specifications of current motor cars that everyday cars using everyday fuel, not premium fuel, are using compression ratios of over 6 to 1.

The Hispano aviation engine, which we started to build in the early days of the War, had a compression ratio of 4.7 to 1, and later on was raised to 5½ to 1. At that time we thought it was very high, even for very heavy-duty service.

Engineers have taken full advantage of the greatly improved fuel available and, in addition, have improved combustion chamber forms to a point which probably has been equally important in increasing the possibilities of higher compression.

Few realize to what extent the current passenger-car engine has gone in approaching or even in exceeding the capability of the old-time racing cars. I have taken off our test sheets at the General Motors Proving Ground a number of figures giving the maximum engine speed coupled with a maximum car speed of a considerable number of cars, and I will read you some of these.

Car	Maximum Speed, Miles Per Hour	Engine Revolutions Per Min.
A	78.3	4250
B	78.1	4350
C	80.3	4350
D	82.0	4700
E	83.1	4700

MOST of these cars are in the lower-price brackets. If anyone had the remotest idea ten years ago, and had so stated, that passenger car engines of conventional type built in large quantity at very low cost, could produce any such speed in operation, he would have been deemed completely crazy.

In addition to their ability to produce this high speed, they can do so and still remain to give other service at a later date, and that was not always true of the old-time racing car. To get this high speed, however, has required not only a much higher degree of factory skill and factory organization, but also a much improved design. This is partly due to the tremendous strains involved—big bearing loads, and other difficulties to be met with at high speed—and also to the outstanding requirement of passenger-car operation that the engine shall be as nearly noiseless and as nearly vibrationless as possible. The result has been obtained by continual addition of material in the proper places.

The conventional six-cylinder crankshaft for one of these

high-speed engines is likely to weigh between 70 and 80 lb., which is practically double the weight of the six-cylinder crankshafts for engines of the same size of 15 years ago. It is true that this weight is partly a matter of counterbalance, but without the counterbalance the job is entirely impossible.

The eight-cylinder type has followed the same road, and the crankshaft weights have gone up accordingly. Even with the heavy crankshafts and big bearings, it has been necessary to add to the crankcase and cylinder block weight. There are two reasons for this; one is the importance of rigidity in holding the bearings in line; and the other, the importance of rigidity in resisting the much higher explosion pressures which go with the very high mean effective pressures now being reached.

This is the history of the past 15 years, and the same trend continues. Cars of the various lower-price ranges next year will have bigger and heavier crankshafts and stiffer crankcases than ever before. They will produce more power per cubic inch, partly by higher maximum revolutions. I do not expect, however, that they will produce much more power per dollar or per pound of weight. That seems to be out of the question where we are held down by requirements of silence and lack of vibration.

It is possible to stay in the van successfully with the modern trend of high-efficiency powerplants, without the use of any of the more specialized materials of construction. It is possible still to build a highly efficient passenger-car engine in which there is no aluminum at all in either the piston, connecting rods or cylinder head. This engine is of practically as high compression ratio and high efficiency, and when it comes to durability, there is no comparison.

You will pardon me if occasionally I refer again to something that has been one of my pet aversions over a long period of time.

High engine-speed has been reached only by a detail improvement in all the small parts of the powerplant. It has required better valves and better cooling arrangements, some means usually of damping the valve springs and preventing valve chatter, much more attention to lubrication —that is, to the proper lubrication at the right time—and lubrication results are little short of astounding.

The motor car today is probably the most versatile piece of machinery that civilization has developed for any possible purpose, the versatility being largely in the powerplant. The motor car passes through crowded city traffic at a crawl; it stands at traffic lights with the engine running; it proceeds into the open country and sets a speed faster than practically any of the regular main-line express trains. It does this without any special attention on the part of the driver, and without the necessity of readjustment before or readjustment after the change in the type of service.

The lubricating system is the foundation upon which this all rests, and it has reached its present high standard again as a result of cooperation between the engineers of the automotive industry and the engineers of the producing oil companies.

I do not see in the immediate future in this country, in any case, any change from the present conventional engine types. I think that we will see a continuance of four-cycle cars. We will see four, six, and eight-cylinder engines as the basis of production. Unless there is a change to a smaller motor car than seems likely now in big production, the desirability of the four-cylinder engine is something of a question. There is still very little reason for more than eight cylinders for the powerplant. For the powerplant of any motor car, the conventional eight-cylinder engines, 350 cu. in. or under, are well within the possibilities of the eight-cylinder design of 125 or 130 b. hp., with satisfaction and with great durability.

Experimental work is going on, especially abroad, on other engine types. However, these experiments usually consist of bringing to life again some old type of design, with the hope that with more modern knowledge, it may be made to work. This applies to engines of the two-cycle type, whether plain or supercharged, or any of their various modifications. These engines had more possibilities years ago than they have today.

Take the modern motor car engine and see what it is expected to do in a widespread range, consider its various characteristics, and you will find there an adequate reason why the present four-cycle type has successfully withstood all of the attempts of other types to oust it from its position.

We have not yet reached the limit of the capabilities of our engines for satisfactory service. There are still possibilities in the factories for making them better; better able to furnish properly and continuously the full capabilities of the inherent design. For an engine to turn up to 4000 revolutions or higher, it must be free-running in all its parts. On the other hand, to be quiet, to take satisfactory care of lubrication, to be gas-tight, it has to be pretty closely fitted. At the same time, the bearing surfaces must be large when the pistons are long and, as a result, only the most accurate fitting will produce the overall result that is desired.

Several things have contributed to improvement of the powerplant today. Among these the muffler should be mentioned. Nothing has done more to release the full capabilities of power in our engines at high motor speeds than the present type of muffler, which depends on tuning rather than baffling to produce the result. This type of muffler has been equally important in silencing the inlet, because with the modern high speed valve timing, the inlet noise without muffling has become nearly as serious a matter as the exhaust noise. That is one of the difficulties in handling a two-cycle design, by the way.

The Transmission System

Improvements in the transmission system during the last five years have come so smoothly and gradually, that one hardly realizes fully what has happened until for some reason he has to drive a car four or five years old, finding, as he does, that gear shifting is difficult even when skillfully handled, and likely to be noisy, and that the gears themselves are so noisy as to be very unpleasant in operation.

We are going to see still better gear boxes in the next few years as design is improved and as manufacturing technique is improved. Needless to say, improvement in manually-operated gear boxes has made it more difficult to justify application of other forms of transmission to the motor car. On the other hand, it does make possible power operation of gear shifting, which in the old days was tried in many different forms without conspicuous success from the customer's point of view.

The synchromesh type of transmission, making shifting quiet as it does, can be handled by power operation very satisfactorily. It is so easy to do it, however, by the usual hand lever, that there seems to be no great advantage in going to power operation except for the purpose of clearing up the front compartment by getting the present gear shift

lever out of the way and the operating handle into a more comfortable position.

I do not expect to see any tendency toward automatic types of transmission in the near future. The possibilities are there and have been there for a long time. They vary from automatic operation of the ordinary three-speed transmission up to automatic operation of practically universal transmissions of the roller type. Automatic operation superimposed on the ordinary transmission rarely seems able properly to meet the multifarious requirements of road driving in the hands of many different users. It is quite easy to upset the régime of any automatic transmission by picking just the right piece of traffic or the right hill, and comparing the operation with a transmission in which not only is the operation easy but the control is by the brain of the driver and not by a preconceived set-up arranged by the engineering department.

The roller-type transmission can go much further than the ordinary type, partly because it can change its ratios under full load. On the other hand, the fundamental trouble with all of these is that when we have them we still have no way of getting away from a substantial amount of engine power. It has, over and over again, been proved that unless the motor bears a pretty definite relation in its size to the weight of the car, the operation of the car will not feel satisfactory nor be satisfactory.

Theoretically it is possible, of course, to climb any hill—or to do any of the things ordinarily done with a motor car at moderate speed—with an engine much smaller than the one that we use. High speed requires high power, however, and a definitely big engine to produce it. When we have the engine to produce that high speed, it is big enough to handle almost every other function of the motor car on high gear, successfully.

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As a result of this engine requirement, it does not seem possible to save anything in the cost of the car to offset the increased cost of the gear box. For that reason, so far it does not seem to me that automatic transmissions of any type are going to be of commercial value on a large scale. As a matter of fact, probably the first automatic types that will come into much use have already seen some service, that is—the overdrive with automatic shift.

My own predilection would be to have the shift controlled by the driver, but there is something to be said for the automatic shift. I had occasion, a year ago, to drive a car with this type of shift on it, and I will say that in the open country, without much other traffic, it was very delightful. It was surprising how much smoother it was, and it is surprising how much smoother even the smoothest engine feels when you slow it down from 3000 or more revolutions to 2000 revolutions. There was a very marked saving in gasoline and oil that went with this; something worth having where high speed operation is common.

This car, however, like most of its kind, produced the automatic shift in the vicinity of 50 to 55 m.p.h. and that, unfortunately, is exactly the speed at which most attempts to pass other cars are made.

I made this trip driving part of the way myself, the rest of the trip being driven by the best driver of an automobile that I have ever driven with. Neither of us was able to handle traffic conditions with it nearly as well as we could have handled them with a standard car, the reason being that the shifting was taking place at just the wrong time to meet the road condition, which happens to be (as nearly as I can find) in the Middle West, an average speed of between 50 and 60 m.p.h. If you check up I think you will find 9 out of 10 cars run at about that speed on the open road.

As high speeds become more important, however, we are going to see more of the overdrive, because it can now be achieved quietly and at moderate cost, and, if an automatic shift proves to be a desirable thing from the customer's point of view, they will probably get that also.

I have some figures on gasoline consumption which indicate the importance of some type of overdrive where there is much very high speed running to be done. General Motors' Proving Ground records last year for the first time took account of gasoline consumption at maximum car speeds, something we have never done before. We found some fairly sad things under these conditions. The lowest figure of any was 6 miles per gal., but that was a rather large car. The highest economy was 11.4 miles per gal. It is fair to say that that car is a smaller and cheaper car with a maximum speed of only 70 m.p.h.

Of course, there is no escaping the fact that part of the low fuel economy at high speed is due to wind resistance, but a good deal of it is also due to the fact that maximum speed in practically all the cars occurs at a point on the power curve where gasoline economy has markedly fallen off compared with the optimum pounds per horsepower hour—and overdrives will very successfully take care of that.

In many cases overdrive-equipped cars drive quite comfortably in the overdrive, even in ordinary traffic. We have become more or less accustomed to expecting an extreme hill-climbing performance, and the acceleration that we get in our standard cars, but it is really quite astonishing how much you can get along without, unless you get into direct competition with someone who has them.

Most of our cars in this country run from 110 cu. ft. per ton-mile up to as high as 124 cu. ft. per ton-mile, which is a measure of their accelerating ability—or should be—and of their hill-climbing ability on high gear. It is quite possible, however, to drive very pleasantly in rolling country, even with a car of only 90 cu. ft. per ton-mile, which would give a very marked saving in gasoline.

Not much change on a large scale is to be expected in the immediate future in clutches. By "large scale", I mean on the motor cars driven by the great majority of people. At the present time something like 94 per cent of all cars sold are sold for less than $900, and there is very little use in worrying our heads seriously over the other 6 per cent in discussing commercial possibilities, except so far as material developed in these higher-priced brackets eventually finds its way through production methods into the lower-priced cars.

I expect to see a very simple form of plate clutch still the leader and expect less tendency to power operation than there has been in the last few years. It is unfortunately too true that clutches, as built until a few years ago, required a lot too much power on the part of the driver's leg to operate them, and something else was better; but it is quite possible today to obviate this without going to the complication of any attempted automatic control.

Chassis

Nothing so new and startling is to be announced at this time as was the switch last year to independent front-wheel suspension. Unquestionably this type of suspension has definitely proved its usefulness in very large production. I do not claim that it is the only way to build motor cars; it is not. There are other good ways to build motor cars. It does do some very useful things, however, that have not been done in any other way.

It permits the use of very much softer front springs. The front springs run about one-third the stiffness of those used before, in fact, resulting in a different type of ride, which is more completely enjoyed in the rear than in the front of a car. They also make it possible to control successfully much softer tires.

The softer tire has been coming steadily on us, being pushed for all sorts of reasons, and in the long run it is adding to the comfort of the owner, although in some ways it requires a little more care to handle. It has also gained ground because of a different urge, the urge for better appearance. The modern type of body design and fender design looks very foolish if put above the old type of smaller-section tire; a big tire is required to carry out the design, and the engineer has got to be able to handle it.

The change in the front-end design did bring an entirely new requirement on frame design. This problem has been

gone into deeply and the work previously done along these lines has been further amplified to determine where and how the proper amount of needed stiffness can be supplied. It is astonishing to find that in spite of all the "alphabetical" frames, the body still supplies something like three-fourths of the torsional rigidity.

It is very fortunate that it does so, because we need all that we have got, and possibly more, to meet the conditions that we have to face.

I do not see any further great change coming in the front end of the car at the present time. It is futile to say that independent springing is essential when half the motor cars do not have it. It is, again, a type of thing that illustrates very completely an engineering compromise that we have to face in producing commercial motor cars. There is no question that independent springing costs rather more than a conventional front axle design. It is equally sure that the advantages of independent springing are not particularly apparent at moderate and slow speeds.

Certainly, the man who uses his car largely to go back and forth to work, at 25 or 30 m.p.h., whose car stands in a parking lot at the factory most of the day, and in a garage or outside his house the rest of the time, gets very little out of independent springing. To get the real results, speeds of 35 m.p.h. and higher are necessary, but at those speeds and higher, there is no question about its value.

It is obvious that, since the industry has started a campaign toward better riding and better roadability, everyone should be looking for further possibilities and that naturally leads toward the rear end of the car. (You will see that I am still discussing the car in its present conventional layout, because, frankly, I do not see any immediate probability of a change in the present conventional layout.)

Two possible constructions have been tried for the rear end of the car, in addition to the one now in common use. One is the so-called DeDion type of axle, using double transverse propeller shafts and a fixed axle, thereby transferring the weight of the differential and bevel gears from unsprung weight to sprung weight. It is also possible with this general driving layout to spring the rear wheel independently.

There is no doubt at all that a car built in one of these two ways would get really worth-while results under certain conditions of operation, but, again, we shall have to make the commercial compromise that the engineer is always facing.

The present conventional construction is distinctly cheaper than either of the other two, and is equally very satisfactory, especially with the present soft tires, in many kinds of service. It is quite easy to tell the difference if you get into a car with the light unsprung weight at the back provided you know the car, and know the car with which you are comparing. But probably the average man who drove down to Long Island one day in one car of a conventional type, and down to the Island another day in a different car, with a dual rear axle, would not be able to pick out one from the other, under the ordinary type of Sunday driving or work of that kind.

To put it briefly, I believe we are eventually going to see something done with the rear end of the motor car away from the conventional layout, but I think it will be some years before it gets into anything but the higher-priced brackets.

The frame as a whole is going to be stiffer, but so far there doesn't seem to be anything very radical in prospect. The welded frame does not seem to be making any headway, due chiefly to practical production reasons.

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Steering

Steering should be mentioned in connection with the springing and running gear and the frame. For reasons that frequently have been explained in publications, there is distinctly more load on the steering gear in independently sprung cars than in cars of the normal type. As a result there has been a big improvement in the quality and efficiency of steering gears themselves. This improvement, which has been forced by the independently sprung car, will react to the benefit of all cars.

It seems only yesterday that the cheap-car steering gear consisted of a very inaccurate little worm and an equally inaccurate little gear, not even in the form of an hour-glass, the worm being pushed on a piece of tube, not even brazed, and the rest of it about like that. Certainly it is a far cry to the present roller-type gear with anti-friction bearings at almost every point. There isn't going to be much design change in this sort of thing, but it will be progressively better due to improved detail design and better manufacturing.

Some groups of accessories needed improvement, and such improvement has taken place. An important one is the electrical equipment. This includes not only the current generating system, but also the lighting equipment. Speeds of cars have gone up very rapidly in the last few years and so far no state has made any motion to indicate that car speeds should be any slower at night than in the daytime. As a matter of fact, this idea was discussed at a National Highway Safety Congress meeting not long ago, and was definitely turned down as being not worth consideration.

Unfortunately, however, the use for many years of a very cheap form of generator and control equipment resulted in making our headlights infinitely better at 30 m.p.h. than at any other speed, the type of regulation used definitely cutting the voltage rapidly as higher speeds were reached, and, due to the well-known qualities of the incandescent lamp, the candlepower available at high speed was sometimes about 50 per cent of the maximum candlepower supposed to be used. The only way to circumvent that was to use low voltage lamps and take a chance on burning them out when you were driving around town, or save them by not using your headlights in town.

This all came along at a time when the Society had, through its influence and through its research work, definitely evolved a very much improved headlight system. Unfortunately, like most things of the kind, it required more candlepower to operate than had previously been used and, at the time we were putting more candlepower into the lamps, we were definitely not supplying it at the generator.

We are going to see a big change in these features in

the near future. Generators are going to be bigger. We will have control systems that will insure, when the headlights are in use at night, the proper lighting voltage, even at the high car speeds, when the light is really needed.

Another thing that came to plague the engineers at a time when starting was giving them trouble anyway, was the radio. Radio sets, even at their best, take quite a lot of current, and seem to be used the most when the car isn't running. Something has had to be done to meet these demands, because the public wants radio. During the last summer, it is understood, sale of automotive radios must have run between 2000 and 3000 sets a day, which gives some idea of why the motor car had to provide for radio whether the engineers think it is a good thing or not.

Much progress has been made toward removing individual annoyances from the owner by various starting devices. Most cars have one kind or another, either push button, or push-the-throttle, or something similar to start the car. We don't know yet that there is any particular "best" along these lines, but all of them in the future probably will be much better in functioning and reliability than in the past.

Foreign makers have gone far in certain directions such as in installation of jacks as part of the motor car. I doubt that we are very close to that in this country. Apparently the average American owner never figures he is going to have tire trouble anyway. As a matter of fact, on new cars, with new tires, there is so little tire trouble that it would be hard to interest the American owner in a device of that kind at any price that he would feel that he ought to pay.

Having discussed the details of the car, a possibly more contentious subject—the general arrangement of the motor car—may be taken up. This must involve the whole question of appearance and, more than that, the question of what has come to be known as "streamlining."

Whatever anyone thinks of streamlining for motor cars, there is no question that streamlining has taken a strong hold on public imagination. We can see it in the advertising pages of any current publication. I don't happen to have seen anything yet about a streamlined toothbrush, but I expect to see that before long. For that reason I think that we are going to see more motor cars that can be called streamlined by the advertising departments, even if the design would make an aeronautical engineer weep.

We have had a year of preparatory work along this line, and there was a lot of preparatory work done before that by many of the companies. So far as any General Motors' road tests indicate, no streamlined cars capable of carrying five or more passengers in the ordinary arrangement have shown a reduced wind resistance sufficient to talk about, compared to much more conventional designs.

The reason for this, as nearly as we can see, is that streamlining in one plane only, at the rear of a motor car, will not accomplish the desired result. If it were possible to draw in the widths as well as to carry the top down on a slope, something could be done, but when the width is maintained at the back of a car, any ordinary slope in the roof line over toward the back produces very little result compared with the most broken line, even with the trunk on the back.

This might be said to be almost equally true of fenders. The best possible way to streamline the fenders on a motor car would be to take them off. Of course, the amusing sight of a beautifully streamlined rear fender on a car carrying a tail lamp just above the fender, with a large rectangular license plate in full sight on some of our most streamlined cars, may have struck some of us as a farce. There is a possibility of help in cleaning up the front end of a motor car, but not a great deal. Headlamps are among the worst offenders, being rather large, and apparently, when placed in position, well calculated to break up the streamline around the front end of the fenders and around the radiator. There is nothing to indicate, however, that unless we radically change the whole layout of the motor car, we have very much to work with. And when I say "change the layout", I mean at least change the passenger arrangement very materially, and possibly go even further than that. There are plenty of objections to most of these possible changes.

The confidence in streamlining of the people who designed the Burlington "Zephyr" was shown eloquently. They lowered the height of the train 3 ft. and reduced the width 1½ ft. in bringing it out, and there is very little doubt in my mind that the reduction in height and width has more effect in the possible speed of the train than any streamlining of the train itself, or of its parts. That does not prevent our well known bus and truck organizations, however, from putting out streamlined buses with the back and front sloped nearly as much as 15 deg. in some cases—and they are probably meeting a public demand by doing so.

The first car of the streamlined variety that was really shown over here to any extent was the Burney car. That had some interesting characteristics, but not many realized how big a car it was. It had a very long wheel base and extremely long overall length, coupled with an engine that was far too small for the weight of the car.

Powerplant vs. Vehicle Weight

When we come to the possible advantages of streamlining, provided we can attain that end in the motor car design, we will have to bear in mind that the power plant—as stated in regard to the gear box—will have to bear a very definite relation to the weight of the automobile.

Maximum top speed of a car has very little to do with the time it takes to go from New York to Boston, provided that top speed is of the order that is now common in all our cars. The important point is how little time you travel at slow speed. That means prompt acceleration, rapid hill-climbing, and other characteristics that go with substantial engine size. The unfortunate fact is that if we attempt to streamline these modern, conventional types of motor car, we almost inevitably add to the weight, making the car longer overall—provided we do not sacrifice the passenger compartment—which penalizes it in traffic and on hills.

The importance of trying to arrive at a streamlined result from an engineering point of view again brings to the front the question of engineering compromise: How many people will benefit from that type of design, provided it has any disadvantages for other car users? Certainly the man who drives in traffic, who goes back and forth to work at the moderate speeds permitted in cities, will get no food whatsoever out of streamlining in any form, and will seriously suffer from it if it makes the cost of the car greater, or if the car is made longer overall and therefore more difficult to park or handle in close traffic.

Undoubtedly sufficient high speed work is done on the open roads in this country to justify streamlining, if it can be arrived at successfully without sacrificing other important qualities. How can it be arrived at? Certainly it cannot be arrived at, in my opinion, without some pretty complete change in the conventional layout of the car as to the seating

of the passengers, and possibly as to the position of the powerplant.

At the present time the widest part of our car is the back and that has become so because of a very definite demand on the part of the public. Many times there has been proposed a car in which the rear seat would seat only two people comfortably, but no one in big production has ever had nerve enough to try it. Whether it could be done commercially, I don't know, but I still feel that there is too much work done at slow speed to justify the sacrifice.

Such a change probably would not affect the operating characteristics of the car, but when discussing streamlining, we are undoubtedly coupling the streamline effect with high speed. Then we must consider not only the ability to go fast, but the ability to control the vehicle at the high speed. That makes the problem far more serious. One very well-known type of fully streamlined model—not built by any manufacturer, but widely spoken of in the papers—is obviously an unsafe vehicle from the general layout. It had a wheel arrangement different from the conventional wheel arrangement. That car justified its appearance last summer by rolling over in Chicago at very moderate car speed. Obviously, things of that kind don't get us anywhere, because if the car isn't safe at high speed, it is much better if it be unable to run that fast.

The same elements have a bearing on the location of the powerplant. It is undoubtedly very difficult in any laboratory to arrive mathematically at the road characteristics of a motor car, but we have accumulated sufficient experience to believe that we can at least come somewhere near to predicting what performance will be with a certain weight distribution. It may surprise you to know that there is every indication that motor cars can be subject to going into a spin at high speed, very much the way an airplane goes into a spin, and that certain weight distributions, one of which is excess of weight at the back end of the car, is very likely to produce an unstable condition of this kind.

It is believed that certain cars today are in this unstable condition, but it covers a relatively narrow speed range which probably is passed so quickly that the driver is able to carry it through by adroit use of the steering gear.

Even if a very complete change in the weight distribution of the car could be adopted successfully, aerodynamic stability questions which may prove to be equally difficult still remain to be faced.

It is my recollection that the fully streamlined cars that have made the speed records on Daytona Beach in recent years have also used tail fins very much like the tail fins of an airplane. They have had to do it to maintain their directional stability. Things like these hardly seem to me to be in place on the commercial motor car.

From an engineering point of view, therefore, I do not see streamlining to be a thing in the immediate future in any large commercial way. On the other hand, I do feel that the public attitude of mind toward it is such that we are going to have a great many more cars next year which will have the streamline look to them. That is largely due to the fact that the public has always wanted fast-looking cars. That is certain.

One reason why, in the old days, people liked the very long car was because it looked faster. They have coupled streamline appearance with speed, and seem to feel that they are getting something when they get it. This being the case, the industry will be only too glad to supply them with it.

In the meantime, the engineering departments are going to put the good old horsepower in the engines and the cars are going to be able to go pretty darned fast anyway.

Brakes

Brakes on a motor car have not come anywhere near keeping up with the rest of the layout. Probably the brakes have gotten better in relation to the increased speed of the car, but what the brakes have to do goes up to something like the square of speed—and that is something else again. Brakes not only have to stop the car but also, in this part of the world with our terrifically heavy traffic, they have a job of control which is fully as important as the mere ability to stop.

Personally, I think that the soul of the automobile brake is the brakedrum. Probably all the engineers feel that way, substantially, and there again, good old cast-iron seems to be awfully good for the purpose.

I think that we are going to see more of that as time goes on—more rigid drums—and that we are going to find a way to make these drums cheap enough to put them on all the cars. With that, the rest of the mechanism will be improved, as it has been from year to year. Unquestionably, brakes this year are better than the brakes last year, and last year's were better than the year before. But I sometimes wish in New York that Detroit wasn't quite such a flat place, and that they had a little more traffic out there with some place like the Queensboro Bridge to drive across once in a while, because it might produce a little different angle on what the brakes have got to do.

Brakes can be improved a great deal, not in direct stopping ability, but in their uniformity of action. It is very important from the driver's point of view to be able to know exactly what his brakes will do at any particular time. Too many brakes in the past have had so-called "morning sickness", which consisted in simply locking the front wheels when you tried to drive out of the garage and wanted to slow down. This resulted from trying to get something for nothing by using a higher degree of self-actuation than was wise with the individual brakeshoes and drums, considering the great difference in coefficient of brake linings, one to another, and also any given time, depending on condition, and humidity in the air.

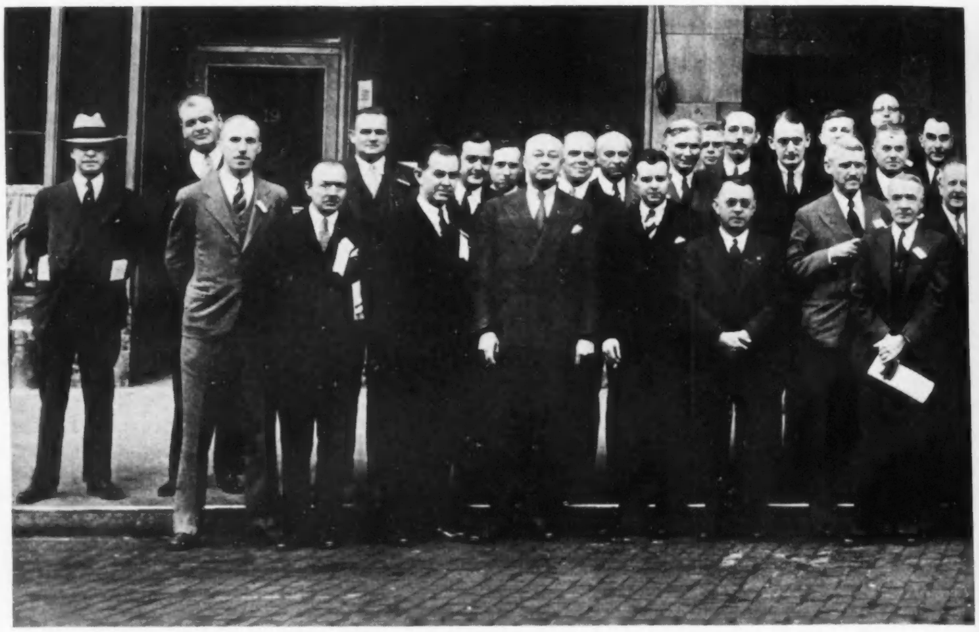
That condition will be understood and treated better and the companies will step up more and more to a realization that, to get brakes to operate well on heavier cars, they will have to use power supplied by suction or by some other means, rather than attempt to wind the brake up individually in each one of four brake drums and expect thereby to get reliable and uniform operation.

These statements may be a little too hard on the brake situation, when one looks back and realizes what has happened to car weights in the last 15 years. The old Model T Ford when it came out weighed about 1700 lb. The present Ford weighs over 2700 lb. Chevrolet used to weigh 1000 lb. less than it does now. That means an increase of 60 to 70 per cent in the car weight. At the same time we are expecting to stop the car much faster than we ever did in the old days. It looks as if we had done a fairly good job, but we are going to do a lot better. We are going to see more and more power applied from the power plant in some form to operate the brakes, rather than expect to do it all with the man's foot plus what assistance he gets from the wrap-up mechanism in the drums.

Few Transportation and Maintenance gatherings have compared in interest with the Regional Meeting held by the Metropolitan Section and jointly sponsored by the New Jersey Motor Truck Association and the Newark Chamber of Commerce in Newark, N. J., Nov. 8, 9, and 10.

With the effective cooperation of truck and parts manufacturers a remarkably fine show was staged in a Newark Armory simultaneously with the meeting. Nearly 5000 visited this exhibit.

In this picture appear some of the 550 transportation and fuel experts who attended the sessions.



Varied Transport Interests Argue

AN outstanding feature of the Regional Transportation and Maintenance Meeting held in Newark, N. J., on Nov. 8, 9, and 10, was its success in bringing together so many interests concerned with the various phases of transportation. Sponsored jointly by the Metropolitan Section, the New Jersey Motor Truck Association and the Newark Chamber of Commerce, the meeting was attended, not only by important members of each of these groups, but also by official representatives of several State and Federal organizations and by one speaker who came from England to address the meeting on an automotive engine subject which proved well worth international attention.

Nor was the meeting confined to highway transportation and maintenance subjects. Air transportation was allotted a full session and the meeting was concluded with a visit to the Newark Airport where the facilities of that organization were inspected and members were offered flights in the new Douglas monoplane in which Colonel Rickenbacker broke transcontinental flight records while the meeting was in progress. Railway transportation in its relation to the automotive types also came in for extensive consideration and one of the important addresses of the meeting was made by the vice-chairman of the Eastern Railroad Presidents' Conference.

J. F. Winchester, who, as president of the N.J.M.T.A. and a member of the Metropolitan Section committee in charge of the meeting was quite largely responsible for initiating the gathering and contributed greatly to its success, sounded a keynote when he pointed out at the opening session that transportation has now taken its place as a major industry. It has been recognized as such by federal action. In bringing this about, he said, the American Trucking Association grew out of an affiliation of trucking associations in most of the states. Recognition has been accorded this association by Federal Coordinator of Transportation, Joseph Eastman, and the belief prevails that both Mr. Eastman and President Roosevelt are inclined to give friendly consideration to reasonable demands of the trucking industry, now that it has organized and has appointed outstanding men from within its ranks to speak for it in an authoritative way. The changing viewpoint of federal officials toward trucking is encouraging, Mr. Winchester indicated, and seems to mark a decided step forward. These statements by Mr. Winchester at the first session brought a hearty response from those present.

In opening the meeting, F. C. Horner, chairman of the initial session, complimented the Metropolitan Section on carrying the banner of the Society in transportation and maintenance activities. To this Chairman Sid G. Harris of the Section responded that the Section is vitally interested in this phase of the Society's work, especially as so many of its members are concerned with the operation of motor vehicles.

For this reason, he said, the Section has recently formed its own Transportation and Maintenance Activity and has appointed T. C. Smith a vice-chairman in charge of this new activity. Mr. Harris read a telegram from S.A.E. President D. G. Roos, who expressed regret at being unable to attend the meeting and complimented the section on arranging so fine a program.

E. W. Wollmuth, executive vice-president of the Newark Chamber of Commerce, welcoming the meeting to Newark, mentioned the danger which besets the transportation industry from critics of large expenditures for highways, some of whom favor imposition of tolls on such roads as the Newark "Skyway." The Newark Chamber of Commerce, he said, has tried to forestall such action against transportation and thus far has been quite successful within its neighborhood. He said that efforts to divert the gasoline tax from use in building and maintaining highways must be opposed, and mentioned the work which New Jersey has done to take

Photos by Lazarnick

Problems at "Met" Regional Meeting

care of the 17,000,000 vehicles from other states which come into or pass through the state annually.

In introducing Major R. F. Britton, director, National Highway Users Conference, who presented the first set paper of the meeting, Mr. Horner said that highway users have the largest interest in the highways and that the Conference aims to knit together these users in such a way that their interests will be given due consideration by legislative and other authorities.

Major Britton urged that it is most important to lay a solid foundation of facts to gain a favorable hearing at the bar of public opinion, especially as highway transport is not receiving such a hearing now. "It is," he said, "being kicked, maligned, burdened and strait-jacketed in a hundred different ways," virtually being placed on trial by its enemies, often without benefit of counsel or a friend at court. He then discussed some of the burdens that are being carried and unfair attacks that are being made, pointing out that the average tax on transportation levied last year amounted to 28 per cent of the value of the vehicles in use, a percentage which no other class of property could bear.

Major Britton outlined several of the steps proposed or taken to tax and regulate motor transport facilities, including the Kansas "Port of Entry" law, which he considers repugnant in policy and wasteful in enforcement, as well as pernicious in other respects. He pointed out that it is the function of the N.H.U.C., as well as of its affiliated state conferences, to mobilize the highway users and call them into action through their own agricultural, industrial and shipping organizations.

C. S. Lee presented the paper written by Gen. H. B. Markham, director of the American Petroleum Industries Committee, which gave an excellent outline of the trend in taxation and regulation of highway transportation. He showed that motor vehicle taxes have increased 300 per cent since 1919, yet this tax curve continues to swing upward. Motor taxes have increased more than one third since 1930, during a depression period when they should have been decreased; 1934 promises further increase in taxation and in restrictive legislation. The paper gave, of course, many outstanding facts relating to federal, state and other motor taxes and made it clear that the automotive transportation industry will have to take energetic action if it is to avoid still more burdensome taxes and restrictive legislation.

Discussion at this opening session related largely to the Kansas Port-of-Entry law. Major Britton in answering said that a careful study of the operation of the law had been made by his organization and that a report on this would be ready shortly. Thus far the law has been generously administered. There appears to have been no adverse effects of importance on shippers generally but some communities have been adversely affected. The law applies only to interstate transportation which is penalized in some respects. This has brought some complaints from neighboring states but no retaliation through other legislative action, though this has been threatened.

M. C. Horine expressed the view that the facts brought out in the paper need to be dramatized and to be widely circulated, as much legislation adverse to motor transportation results from lack of understanding of the facts and from adverse propaganda put out by better organized interests who distort the true facts.

Thursday's luncheon program was introduced by Fred M. Rosseland, manager of the Newark Safety Council, who complimented those trucking interests which have made enviable records in promoting safety in the operation of their equipment. Human, financial and self-preservation motives help to bring this about, but education and proper enforce-

ment of regulations are important, he said. He then introduced J. J. Shanley, chief inspector of the New Jersey Motor Vehicle Department, who explained some of the difficulties faced by enforcement officers. Licensing, school patrols and safety campaigns have helped to reduce accidents, but deaths from motor vehicle accidents are still far more serious in total casualties than the major disasters which get so much attention in the press. Effective enforcement of safety and other provisions can be had only through cooperation of the public, yet there is still studied evasion in some cases which is destructive of morale in the enforcing agencies.

From a strictly engineering standpoint, the Thursday afternoon session was one of the most important. It was devoted to Diesel engines.

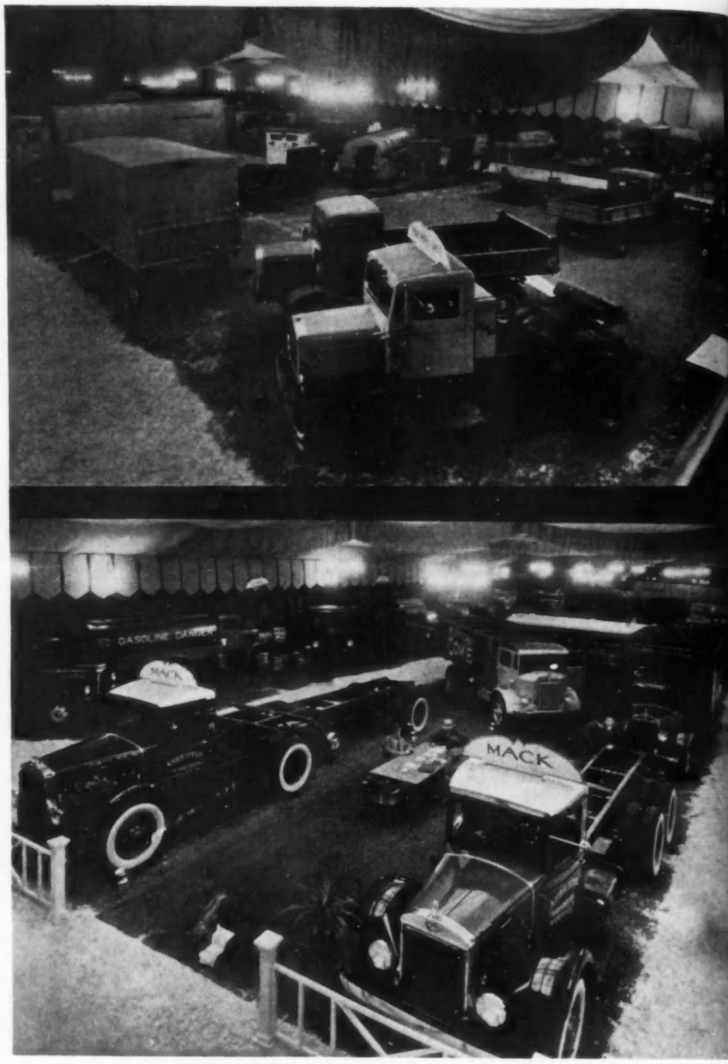
N. Mitchell of the Asiatic Petroleum Co., Ltd., London, spoke on High-Speed Compression-Ignition Engines for Passenger Vehicles and Trucks. Most of his data were based on records of the London General Omnibus Co., which now has over 400 buses with compression-ignition engines in service. Mr. Mitchell said that the fuel saving made with this type of engine is admitted but that the cost of maintenance is somewhat higher than that of the gasoline types. The net saving is sufficient and the general performance is so good, however, that it is possible that the L. G. O. will not purchase any new gasoline engines when new equipment is being bought. There are, he indicated, about 6000 vehicles, chiefly buses, now using compression-ignition engines in England, and the number is rapidly increasing. He briefly described the types in use and gave performance data. The higher maintenance costs are being reduced as experience is gained. The engines weigh about 10 lb. per hp. and are often combined with fluid flywheels and special gearboxes.

Those participating in the discussion included E. S. Marks, Austin M. Wolf, W. E. John, A. A. Lyman and Martin Schreiber of the New Jersey Public Service Coordinated Transport; Clinton Brettell, J. F. Winchester, T. C. Smith, B. B. Bachman, Harte Cooke, and Herbert Chase. Much of the discussion consisted of questions about the type of equipment used in England, about its performance and of comments to the effect that the data given should not be considered as applying necessarily in this country because of differences in the cost of fuel and labor and in other conditions which are not the same in both countries.

Answers were to the effect that cleaning of combustion chambers at 8000-mile intervals is more a matter of custom with gasoline engines than because of a specific need. Lead-bronze bearings have given better service in most instances than babbitt, but the latter is satisfactory in some instances. Smoke can be eliminated by proper fuel feed, and proper combustion chamber design but some odor occurs. The public soon becomes accustomed to the difference in odor as compared to that from gasoline exhaust and does not object.

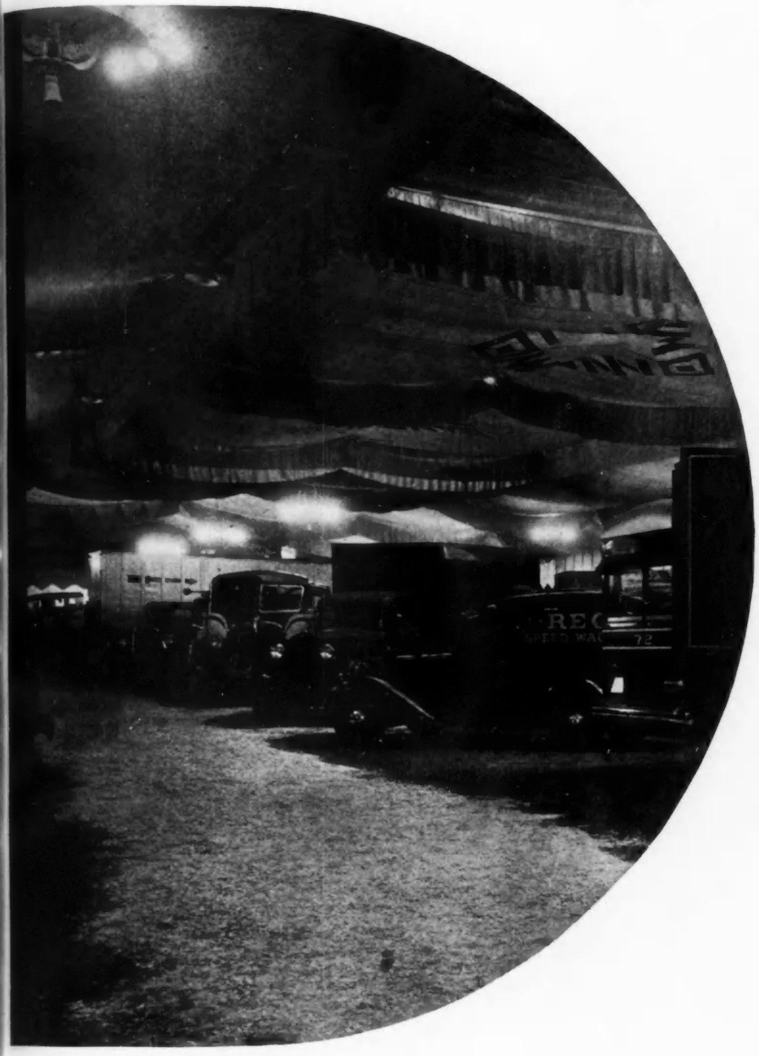
No difficulty is encountered in starting in weather as cold as it ever gets in England, providing the starter itself works properly. There is little difference in the cost of replacement parts, and wear is not excessive on parts that are properly designed and hardened. The relative manufacturing cost is estimated at about 15 per cent above that for gasoline engines.

In response to some comments to the effect that it has been difficult to interest American truck manufacturers in Diesel engines for production jobs, Mr. Bachman pointed out that this is partly because the demand for trucks with Diesel engines is small and scattered. In addition, all the Diesel engines available to date are rather large and suited only for large trucks which are not in great demand. It is difficult to make a profit on specially equipped trucks. Those with Diesel engines may yield advantages under particular conditions, but these conditions are not widespread.



Thirty-five different truck, bus and parts companies exhibited their latest units at the transportation show held at the Essex Troop Armory as a corollary of the Regional Transportation and Maintenance Meeting.

Mr. John pointed out that there is a large saving in fuel with the Diesel engine, even if the fuel cost is about the same per gallon as gasoline. Mr. Winchester mentioned possible difficulties in service especially when the user does not have his own service organization. His own observation of vehicles using Diesel engines in England were that they produced smoke which would not be tolerated here if the number in use were large. Mr. Lyman stated that the results reported in the paper check quite well with the experience of his own company with Diesel-engined buses in this country. Some disagreeable odor but no smoke was encountered. The parts on Diesel engines are somewhat simpler and there are no road failures from electric ignition since none is used, whereas the ignition system is the chief cause of road failures on gasoline-engine buses. Mr. Brettell pointed out that the truck user must, in general, buy a complete vehicle, including engine, and cannot chance a new type unless regularly furnished by the truck manufacturer. The latter have not yet



More than five thousand people interested in the use of highway transport visited this successful show during the three days and evenings that it was open.

been willing to go along with the Diesel. Mr. Smith said that there is no such thing as an "average case" in truck service; that is, service conditions vary widely. Present Diesel engines do not fit in well with the smaller, lower mileage jobs. Mr. Schreiber of N. J. Public Service said that the results quoted by the author are in line with information he had secured from the L.G.O. When that large and experienced operator is about to drop the gasoline engine in favor of the Diesel, it is time to take notice of similar advantages that may be realized in this country. Bus manufacturers here are opposed to the Diesel engine and this is the principal reason it is not used by large bus operators. In his view, it is time that the operators and manufacturers wake up to the trend in England, especially as the limited experience with Diesel engines in buses here has been favorable.

Mr. Cooke spoke enthusiasticlly about the possibilities of the Diesel, indicating that such higher costs in maintenance as may be encountered now will soon be overcome. There is, he said, no carbon monoxide in the exhaust and no smoke or odor with full power. Both will be eliminated under other conditions, though this is more difficult in smaller engines. He mentioned the success of the Diesel in switching locomotives but predicted that the only way to get Diesel engines into trucks is for the user to demand them. Mr. Lyman added that when his company wanted to buy a six-cylinder Diesel engine for bus service four years ago none were available in this country and sample engines had to be brought from Europe. Today several such American engines are available. T. B. Rendel acted as chairman of this session.

J. M. Fitzgerald, vice-chairman of the Eastern Railroad Presidents' Conference, was the principal speaker at the informal dinner on Thursday evening. He was introduced by Dean A. R. Cullimore of the Newark College of Engineering. Mr. Fitzgerald's subject was, "Transportation Coordination—What Does It Mean?" He made it clear that the economy of motor transportation is sound. Such transportation is here to stay and must have a place in any coordinated system. Shippers, he continued, desire to deal with a single agency that is financially responsible, but this does not necessarily mean consolidation of all agencies. Difficulties arise, however, if only a part of a coordinated system is subject to government regulation, which has resulted in the case of the railroads, from a demand for a stable rate.

Mr. Fitzgerald quoted Joseph Eastman as believing that all common carriers need regulation, indicating that the public would not be satisfied with self-regulation of all forms. No profit to anyone can result in the last analysis, Mr. Fitzgerald said, from destructive competition. Government regulation for all forms is necessary and cooperative effort is required for a properly coordinated system. The public interest must be paramount and the public will demand the highest type of service at the lowest rate. Neither the railroads nor highway transportation can handle all traffic. Each must take the field where it can render the best service. This address seemed to be regarded as a temperate and reasoned plea for cooperation and was heartily applauded by the audience.

Thursday evening's session was devoted to code and rate matters, and was presided over by Robert Jackson, chairman of the N. J. State Code Authority for the Trucking Industry. T. V. Rodgers, president of the American Trucking Association and chairman of the Federal Code Authority for the Trucking Industry, made the first address. He said that when his work was started there was no national organization in the trucking industry and it was necessary to develop one to cooperate with the government in code and related matters. This was done largely through the formation of the American Trucking Association with affiliated associations in most states. Results included the establishment of a 48-hour week, the addition of some 300,000 workers and about a 20 per cent increase in the industry's payroll. About 270,000 vehicles have been registered under the code and efforts to establish fixed rates based on costs are being made. Shippers who consider rates too high can always establish their own service. The code has given thus far about six months of national self-regulation and the trucking industry is on the road to effective control of its own business. Cost formulas to control rates are being worked out.

Mr. Rodgers said that Federal Coordinator of Transportation Eastman had advocated a strong central organization of the industry. Some permanent control over highway transportation, probably involving some form of federal regulation and continuance of a code appears inevitable, said the speaker. The Eastman bill, as introduced at the last session

of Congress, provided for placing interstate trucking under the Interstate Commerce Commission, but this would have affected only 50,000 vehicles in all, had the bill been passed.

F. I. Hardy, an industrial engineer and truck fleet operator of Boston, delivered the second paper in which he discussed the Economical Application of Rates for Movement of Freight by Trucks. He indicated that rates must be based on cost plus a fair profit and then discussed means for arriving at costs, indicating in some detail what they should include and providing a simplified cost-keeping form which was distributed to those interested.

Most of the discussion of the papers consisted of questions about details of code operation and the methods used in getting truckers to subscribe to the code and register their trucks under it. Those who participated in it included C. F. Jackson, Fred Nelson and George Daniels, the latter being chairman of the N. Y. Code Authority for the Trucking Industry.

Fuel Session

The fuel session on Friday morning, presided over by W. E. John, vice-chairman of the Metropolitan Section, proved to be one of the best of the meeting from an engineering standpoint. It opened with a showing of motion pictures of fuel tests of 1934 cars on Uniontown Hill, accompanied by a running description provided by C. J. Liddell, test engineer, Doherty Research Co. This was followed by two papers dealing with the use of butane and propane as fuels and refrigerants, and by a talk in which M. C. Horine described a temperature control system for refrigerated trucks, developed by the Mack company, and outlined the uses to which trucks equipped with this system may be put in serving the food industry.

W. Z. Friend presented the first paper, which he and E. Q. Beckwith had prepared on propane and butane as motor fuels. This paper contained a summary of the qualities of the fuels, gave facts about the available supply and its source, and described practical tests made with this fuel in comparison with gasoline, as well as some of the equipment required for its utilization in motor vehicles. The second paper by Guy L. Tinkham, of the McCord Radiator & Mfg. Co., on truck refrigeration with propane was presented in the author's absence by J. G. MacCormack. It describes the system developed under patent license by McCord for using propane in cooling truck bodies, its operation and various practical considerations in its use for this purpose and in the air conditioning of buses and motor-driven railway coaches. Refrigeration is produced, of course, by absorption of the latent heat of vaporization of the fuel in passing through the cooling coils on its way to the engine. As the fuel is an excellent one for an automotive engine, especially if its compression pressure is raised enough to assure most efficient use, the refrigeration is a by-product which costs nothing except for the installation and maintenance of the equipment required.

Mr. Horine in his talk dwelt quite largely upon the need for close control in the temperature of perishable foods if they are to be delivered to consumers in prime condition. About $16,000,000,000 worth of perishable food is consumed annually in this country and much of this must be delivered speedily at a constant low temperature if spoilage is to be avoided. Railway facilities with ice refrigeration are not adequate in many cases, for lack of either temperatures that are low enough or nearly enough to being constant to prevent deterioration. There is thus a great opportunity, Mr. Horine stated, for increase in highway transportation of foods of certain perishable types in properly equipped trucks having refrigerated bodies in which the temperature is kept constant within one degree, as is possible with the Mack control. This consists of a sensitive thermostatic element which controls motor-driven blowers in such a way that, with a proper refrigerating means, air within the cooled compartment is circulated and maintained at the temperature required. This circulation maintains the same temperature at the top and bottom of the box as well as at other points, regardless of the conditions outside, and consequently keeps the contents at the constant temperature desired. This has been demonstrated in seven-day tests during which a truck so equipped has been run 1250 miles. Any refrigerating means capable of giving the temperature desired can be employed. Fresh milk has been kept sweet and wholesome for nearly a year by storage under a constant low temperature, Mr. Horine said.

Discussion was delayed until all papers had been presented. A written discussion of the first paper, prepared by J. H. Freyermuth, was presented by Mr. Blackwood. This pointed out that conditions at eastern refineries do not permit them to market much propane or butane, though much of each is made in refining processes. Both are used in gasoline, as a rule, and are not available as a competing fuel at a lower price, though they are used to some extent, chiefly for industrial purposes, on a contract basis. Some supplies are shipped from western refineries, but the freight rates are the same as for gasoline and add considerably to the delivered cost.

Asked about the possibility of lower freight rates, Mr. Friend said that efforts to have them reduced had proved unavailing. Though the fuel itself is lighter than gasoline, the tanks required for shipment are heavier and the gross load about the same. Installations for storing and using butane do not increase insurance in industrial plants if made to underwriters' specifications. As yet there is no underwriter specification for truck installations, but one is being prepared. There is no federal tax on this type of fuel.

Butane and Propane Discussed

A. Ludlow Clayden said that butane and propane are very fine fuels and the latter might be considered for aviation purposes if suitable equipment for using it were developed. The use of liquid fuels which are converted into dry gas at normal atmospheric temperature and pressure may be expected to increase, Mr. Clayden believes. Mr. John spoke of butane as an excellent fuel for railcar use, saying that it had been employed on a Union Pacific train for 55 days without need for the train visiting a maintenance shop, which is much less frequently than with conventional fuels. As there was no crankcase dilution, lubricating oil, formerly requiring change each 800 miles, was later used 8000 miles without change. Maintenance charges also decreased, and the power increase resulted in faster acceleration and better schedule. In another instance, involving ten trucks converted for butane use, a 40 per cent saving in maintenance cost resulted, so that a net saving would be realized even with fuel about the same price as gasoline.

Mr. Brettell inquired whether a discharge of propane to the atmosphere such as one speaker said might result in refrigerated trucks under certain conditions, would not create a fire hazard. He also asked whether the reconditioning which usually accompanies a changeover from gasoline to a

new fuel might not itself account for a part of the improvement noted. To this the reply was that there is little if any discharge of fuel with a properly designed refrigerating system. Reconditioning has some effect, and the fuel consumed naturally varies with conditions, but can be made the same or lower for butane and propane than for gasoline if the compression pressure of the engine is increased, even on a gallonage basis.

Operating Experiences

At Friday's luncheon, the scheduled program was departed from somewhat to permit of several short talks on specific experiences of operators. Dean Franklin DeR. Furman of Stevens Institute of Technology was the first speaker introduced by T. C. Smith, who presided. He said that complex problems are often simplified greatly by getting a firm understanding of the fundamentals involved. Mr. Brettell said that efforts to reduce operating cost in the Macy fleet had led to experiments with retreading of tires, following similar experiments on the west coast, and that some economy had been realized by so doing.

Capt. George E. Gray, of the Shell Eastern Petroleum Products, Inc., mentioned difficulties which his company had in respect to legislation on loading and speed. Some economies had been realized, he said, by reducing the weight of trucks and their equipment in order to permit of carrying a greater pay load. Some states, he added, are now requiring a minimum speed of 20 m.p.h. on 4-per cent grades. This means a larger and less economical engine or some change in gearing which may in turn lead to excessive speed on the level, thus adding a hazard in one form to gain safety in another. F. K. Glynn, of the American Telephone and Telegraph Co., outlined tests which his company had made to determine what should be spent on cleaning, polishing and refinishing to maintain trucks in satisfactory condition from an appearance standpoint. It was first necessary to establish standards as to what constituted satisfactory appearance by preparing panels that had been weathered and cleaned in certain ways, and then to compare these with the finish on bodies and hoods of trucks. The comparison also afforded a check on methods followed at different locations as they affected upkeep from an expense and appearance angle.

A. G. W. Brown, equipment engineer, Jamaica Buses, Inc., raised the question as to how much safety could be promoted by mechanical safeguards acting automatically. Such devices, when effective in themselves, may tend to make the driver careless, so that if the devices fail to function as intended, safety may be sacrificed. He said it is often difficult to meet lighting requirements, especially when generator output is limited and when an aisle filled with standees prevents light from reaching seated passengers in desired amount. He is convinced, however, that clean vehicles do help to draw increased traffic. J. N. Bayne, International Motor Truck Co., criticised the inaccessibility of "hidden" small parts or units which it is difficult to get at in servicing. He indicated that it would reduce service cost if such elements were made more accessible.

J. F. Winchester stated that some of the problems which give him concern are frequent new models, demands for new "styling" or appearance, load limitations, cost practices, and the need for meeting 48 different sets of state regulations.

Mr. Winchester presided at a part of the afternoon session on Friday, when the highway session was in progress, and introduced New Jersey State Senator Joseph G. Wolber who presided for a time. Senator Wolber said that, in his experience as an official, he had found that unsatisfactory legislation often results from a lack of good information. He said that more contact with those who know the facts—as in meetings of this kind—is very desirable.

G. E. Clinton, traffic manager, Sheffield Farms, presented the first paper at the highway session. He criticised regulations which bar trucks from such highways as the Newark Skyway, saying that truck operators want the right to use the highways for which they help to pay. He said the operators want and strive for safety in operation, but are unable to understand the reasons for such limitations as those for length of 35 ft. for trucks and 45 ft. for truck-trailer combinations. Climatic conditions are paramount considerations in the damage caused to highways and are so recognized by their designers in many states. In respect to the proposed uniform bills for highway use, Mr. Clinton declared that he does not favor these because of the different operating conditions which prevail in different localities. In any event, the reasons advanced for uniform legislation are not adequate.

In commenting on this paper, Senator Wolber said that it is evidently desirable to think twice before legislating on matters affecting transportation. He then introduced the second speaker, W. J. Sloan, engineer, N. J. State Highway Commission, who, he said, deserves great credit for his work in developing the excellent highway system of the state. Mr. Sloan spoke on "Planning and Administering Highway Systems for Greatest Usefulness," outlining the basis on which highways are designed to handle the traffic they must carry, and saying that they must be so designed as to reduce the cost of operating over them to the lowest justifiable minimum. Such factors as type of vehicle which is to use the highway, the type of pavement employed, the grades permissible and the delays imposed by traffic are taken into consideration.

Since New Jersey roads, or some of them, cost 50 to 75 per cent more than they would otherwise were it not for the peak traffic of week ends and holidays, involving but little gasoline consumption, Mr. Sloan questions whether the burden of constructing and maintaining the roads is equitably divided among the users. When asked about this in the discussion, Mr. Sloan said that, in his belief, the answer lies in higher license fees for the passenger car.

Coordination of Facilities

William H. Connell, representing the Port of New York Authority, spoke of the work it has done in helping to coordinate truck and rail transportation facilities by providing better terminal and interchange facilities for freight. At the inland freight terminal established by the Authority, 383 trucks called in one day with l.c.l. freight which was loaded on 60 trailers for delivery to railheads, thereby obviating calls at all the railheads by the 383 trucks with consequent delay and waste in time. In some instances a truck load of warehouse freight requires only a 15-minute trip to the inland terminal when formerly it would have taken a half day to distribute to railheads.

W. E. Olen, president, Four-Wheel Drive Auto Co., pointed out that when Federal aid to highway construction came up at the last session of Congress it was turned down until subsequently based on a plea for safety, after which $860,000,000 was appropriated. To secure its share, Wisconsin made a survey which showed that 25 per cent of accidents can be attributed to road surface outside of cities and about the same percentage to vehicle faults. If unfavorable legis-

lation is to be avoided, much must be done to improve both the roads and the vehicle. Efforts toward driver education must also be fostered, Mr. Olen believes.

There was considerable discussion of the New York requirement providing that vehicles be capable of stopping in 22.5 ft. at 20 m.p.h. This is so close to the limit that skidding is likely to result. Mr. Brettell agreed that this is close to the skidding limit but added that a still more difficult provision is for a 50-ft. stop at 20 m.p.h. using hand brakes only. When so set as to meet this requirement, a few applications result in damage to brakes or other parts. The requirement is futile because in an emergency, the driver seldom can use the hand brake in time to be effective anyway. J. F. McMahon, Checker Cab Mfg. Corp., said that, although the rapid stops required can be made with taxicabs, passengers are likely to be thrown from their seats and some 30 per cent of the accidents reported by his company had resulted from this excess braking ability.

Mr. Winchester, in closing the session, said that he felt it had been very helpful, especially in the interests of safety.

At the Friday evening dinner, Dean A. M. Green of the Princeton School of Engineering, introduced the principal speaker, James S. Marvin, assistant general manager of the Automobile Manufacturers' Association, who spoke on manufacturers' problems. Mr. Marvin said that taxation and legislation constitute outstanding problems. Facts are being gathered from the 260,000 trucks now registered under the code, in an effort to answer the attacks on trucking being made by the railroads, Mr. Marvin said, and pointed out how the latter had fostered legislation inimical to trucking interests. He added that the automotive manufacturers want the railroads to be efficient and that they furnish them about 13 per cent of all their freight. In adjourning the meeting, Chairman J. N. Bayne said that if government regulation of trucking comes about, government ownership of trucks may be the next step.

Remarks by Lieut. Richard Aldworth, manager of the Newark Airport, scheduled for the aviation session on Friday evening had to be omitted, because of the illness and absence of Lieut. Aldworth. The latter sent a hearty invitation for those interested to visit the airport the following morning, however, and many took advantage of this invitation, some making a trip over New York in the new Douglas monoplane with which Colonel Rickenbacker established a transcontinental record during the time the meeting was in progress. The facilities of the airport were inspected, as were also several planes at the port.

Clarence D. Chamberlin presided at the aviation session, introducing E. P. Lott, vice-president in charge of operations of the National Air Transport, who spoke on the "Business Utilization of Air Transport Facilities—Economic Maintenance and Safety Features." This paper described the facilities of N.A.T. and outlined the methods followed in the operation, control and servicing of its equipment. He said that present schedules are about 50 m.p.h. faster than those prevailing two years ago.

Most of the discussion on this paper was in the form of questions on such items as the intervals between servicing, the work done in servicing, the methods of de-icing and the policy of obsolescence followed. A. L. Beall inquired about gasoline purchase specifications as affecting ice formation in the carburetor and inlet manifold. The speaker indicated that operating conditions probably had more to do with this matter than the character of fuel used. It is controlled, so far as possible, by applying heat to the parts affected. Mr. Chamberlin asked about blind (instrument) landing and possible stratosphere flying. The author said progress is being made in the former: it is done on test planes but is not yet considered safe enough for transport ships, though it may be before long. Stratosphere flying depends in part upon development of means for supercharging cabins.

The concluding speaker was F. R. Neely, chief of the Information Bureau, Aeronautics, Department of Commerce, who gave an outline of the new air regulations of the department. These apply first to transport and for-hire planes and secondly to planes for private use, the regulations being quite different and chiefly in the interest of safety. Efforts to cut red tape as affecting private flying and to foster the development of inexpensive but fool-proof and exceptionally safe planes have been made and are bearing fruit. Most of the discussion consisted of questions on details of the requirements.

Preprints of most of the papers and transcripts of the discussion are available through the Society office.

An unusually good truck show, held at the Essex Troop Armory, was visited by most of those who attended the meeting. Many new developments were shown and there were several streamlined truck bodies in evidence. Buses, numerous stripped chassis, and many trucks with different types of bodies mounted, various forms of trailers, as well as many engines, parts and accessories were on display. A list of the exhibitors follows:

Autocar Sales & Service.
Bendix Westinghouse Co.
Brockway Motor Truck Co.
Brodie System Co., Inc.
Burnet Rubber Co.
Chevrolet Motor Co.
Cummins Diesel Engine Corp. of N. Y.
Day Elder Motor Truck Co.
Diamond T Motor Car Co.
Dodge Brothers Co., S. H. Grossman, Inc.
Egyptian Lacquer Mfg. Co.
Federal Motor Truck Co.
Fitz Gibbon & Crisp, Inc.
Four Wheel Drive Auto Co.
Fruehauf Trailer Co.
General Motors Corp.
Hegeman-MacCormack
Heil Company
Hercules Motors Corporation
International Harvester Co. of America
Mack International Motor Truck Corp.
New Jersey Motor Vehicle Dept.
Northern New Jersey Trailmobile Co.
Reo Motor Company
Society of Automotive Engineers
Standard Oil Co.
Ralph Starks, Inc.
Sterling Motor Truck Co.
Stewart Sales & Service
U. S. Army Trucks
Walter Motor Truck Co.
Waukesha Motor Co.
Wheels, Inc.
The White Co.
Wire Wheels Corp.

Annual Meeting Gives Rich Promise in Technical Fare

EVERY professional activity of the Society will be represented adequately on the five-day program which is nearing completion for the Annual Meeting in Detroit, Jan. 14 to 18, inclusive. From the Transportation and Maintenance Session which opens the proceedings on Monday, Jan. 14, to the Production Symposium, which will be the last technical session on Friday, Jan. 18, the program is an exceptionally full one—full of technical meat, full of interest for everyone, including the students for which the Detroit Section has provided a special session.

It will be a meeting arranged with an eye to its providing fitting technical tribute to the fact that it occurs in the year of the Society's 30th Anniversary. It will have special 30th Anniversary features of historical interest, scores of important committees will meet, and many important decisions will be made.

The detailed program is exceptionally complete for a period so far in advance of the actual meeting, and the interest of its contents justifies giving serious consideration NOW to reserving the time for YOUR attendance at the meeting.

Screw-Thread Standards Revision

AMONG many important matters to come before the Standards Committee and Council of the Society at the Annual Meeting in January is consideration of a proposed revision of the American Standard for Screw Threads. This revision was undertaken by a sectional committee, working under American Standards Association procedure, with the S.A.E. and the American Society of Mechanical Engineers as co-sponsors. It includes important changes in existing standards and much new matter. Members of the Screw Threads Division of the Standards Committee have already received the text. Contingent upon their approval, it will pass to the plenary Standards Committee for approval, and then to the Council.

The tentative revision of the Standard covers dimensional specifications for American screw threads applicable to bolts, machine screws, nuts, tapped holes and other threaded parts. The Sectional Committee responsible approved it by letter ballot. The poll resulted in the following division of the voting:

Approved	30
Approved with comments	6
Disapproved	1

For the purpose of correlating the tentative revision with existing standards appearing in the 1933 edition of the S.A.E. HANDBOOK, the Standards Department of the Society prepared a tabular analysis which is reprinted below. This analysis gives a good idea of the classifications of material included in the revision. In the tabulation, the third column heading "Revised American Standard" refers to the text of the revision as published by the American Standards Association with the designation (ASA Bla-1934) to identify it.

Engineering Display

The Engineering Display, which has been such a conspicuous and successful part of Annual Meetings in recent years, will have an important place at the forthcoming Annual Meeting in Detroit. All space available for exhibits has been reserved as the JOURNAL goes to press, which indicates high interest in the display by exhibiting manufacturers, with high technical quality and interest in the exhibits themselves.

Corresponding Text and Tables of Revised American Standard and Present S.A.E. Standard

Item No.	Text of Reports	Revised American Standard: Refer to	Page	1933 S.A.E. HANDBOOK: Refer to	Page
1	Preface		6		
2	Introduction		7		
3	Thread Form		7		512
4	Thread Series	Table 1	8	Table 1	511
5	Thread Series	Table 2	8		
6	NC—General Dimensions	Table 3	9	Table 2	513
7	NF—General Dimensions	Table 4	10	Table 8	518
8	Terminology and Symbols		11, 12		
9	Thread Fits		13, 14		
10	Thread Fits		16, 17		
11	Allowances and Tolerances	Table 5	15		
12	Allowances and Tolerances	Table 6	15		
13	Allowances and Tolerances	Table 7	15		
14	Allowances and Tolerances	Table 8	15		
15	NC—Class 1—Screws	Table 9	18		
16	NC—Class 1—Nuts	Table 10	19	Table 3	513
17	NC—Class 2—Screws	Table 11	20	Table 4	514
18	NC—Class 2—Nuts	Table 12	21	Table 5	515
19	NC—Class 3—Screws	Table 13	22	Table 6	515
20	NC—Class 3—Nuts	Table 14	23	Table 7	516
21	NC—Class 4—Screws	Table 15	24		
22	NC—Class 4—Nuts	Table 16	25		
23	NF—Class 1—Nuts			Table 9	518
24	NF—Class 2—Screws	Table 17	26	Table 10	519
25	NF—Class 2—Nuts	Table 18	27	Table 11	519
26	NF—Class 3—Screws	Table 19	28	Table 12	520
27	NF—Class 3—Nuts	Table 20	29	Table 13	520
28	NF—Class 4—Screws	Table 21	30		
29	NF—Class 4—Nuts	Table 22	31		
30	8 Pitch—Class 2—Screws	Table 23	32		
31	8 Pitch—Class 2—Nuts	Table 24	33		
32	8 Pitch—Class 3—Screws	Table 25	34		
33	8 Pitch—Class 3—Nuts	Table 26	35		
34	12 Pitch—Class 2—Screws	Table 27	36		
35	12 Pitch—Class 2—Nuts	Table 28	37		

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News of the Society

R. E. Wilson Talks At Regional Meeting

● South Bend (Regional)

For the second time this year, an eminently successful regional meeting was held in South Bend, Ind., with the cooperation of the Chicago Section.

The date of the recent meeting was Nov. 7 (evening), and the speaker was Dr. R. E. Wilson, director of research, Standard Oil Co. (Indiana). Dr. Wilson took as his subject "Recent Developments in the Manufacture of Motor Oils." D. G. Roos, president of the Society and chief engineer, Studebaker Corp., presided at the meeting.

Lubricants Discussed in Detail By Three Speakers At Meeting

● No. California

THE November meeting of the Northern California Section was entirely devoted to lubricating oils and other lubricants. The first paper was presented by E. W. Hutton, manager of lubricating oil sales, Union Oil Co., who discussed "The Use of Solvents in Modern Refining of California Motor Oils." Mr. Hutton pointed out that in 40 years the number of automobiles had increased from four to approximately forty million, and that improvements had been continuous during this time.

The modern high-speed and high-compression automobile needs a high-quality motor oil to properly conduct its operation. It has, therefore, been necessary for the petroleum refiner to keep pace in his manufacturing methods with the development of the modern motor car.

The automobile purchased by the modern family in general represents their largest single investment, and it is to be expected, therefore, that it is watched with a great deal of pride, and that the motorist is desirous of obtaining the best possible products to insure proper operation and long life.

The investigations and research work of the Union Oil Co. have indicated that all the crudes produced in this and in foreign countries contain approximately the same series of hydrocarbons, and that it is only in the proportions of these various types of hydrocarbons that the crudes vary. The California crudes contain a proportion of the paraffin type of hydrocarbons and the Pennsylvania crudes contain certain proportions of naphthene hydrocarbons. The Union Oil Co.'s new process has, therefore, been developed to obtain the paraffin type of hydrocarbons from California crudes. Their work on the oils so produced has indicated that the best insurance covering economical maintenance of the automobile engine is adequate and intelligent lubrication. The so-called "normal wear" in Mr. Hutton's opinion is a bugaboo and can mostly be overcome by the selection of the proper type of lubricating oils.

The method used by the Union Oil Co. was briefly described and demonstrated by Mr. Hutton assisted by Mr. Jenkins of their research laboratories: Lubricating distillates are first fractionated under vacuum from one of the waxy California crudes such as Santa Fe Springs Crude, and then are mixed with propane under pressure at a temperature of 90 to 100 deg. Fahr. At this temperature the propane dissolves all of the lubricating oils and the wax, but will not dissolve the asphalt which is precipitated in the bottom of the chamber and drawn off. After the de-asphalting, the solution of oil, wax and propane is passed to another container with the addition of further propane and the pressure is released.

The evaporation of the propane acts as a refrigerant and the temperature of the solution drops to approximately forty degrees below zero; the wax crystallizes and precipitates and is in turn drawn off. This de-asphalting and dewaxing produces an oil of approximately 55 viscosity index from one which would normally finish to about 20 viscosity index. The oil is then passed to a solvent treatment using a mixture of sulphur dioxide and benzol which dissolves the naphthenes, unsaturated compounds, etc., leaving as a raffinate the paraffin type of hydrocarbons having a viscosity index of approximately 100.

The resultant motor oil is characterized by high flash and fire, great resistance to oxidation, V.G.C. below 0.810, approximately zero pour point and low carbon residue.

The second paper was presented by R. W. Phelps, assistant vice-president, of the American Can Co., who discussed the "Development of Packaging Motor Oils in Cans," and told how rapidly this method of marketing the modern motor oil had developed throughout the United States. Mr. Phelps also showed a moving picture which clearly demonstrated how these cans are manufactured and showed refinery operations where the cans are filled and placed in their cartons for shipment to the retail trade.

F. L. Wagar, manager of automotive lubricant sales, Associated Oil Co., gave a paper on subject "Specific Lubricants for Specific Automotive Uses" and pointed out the value of different types of lubricants made with different viscosity oils and various soap bases and that each was designed for some specific use. He emphasized the necessity of keen judgment in the selection of the proper lubricant to fit the specific conditions depending upon load, speed, exposure to the elements, etc.

Strong Presents His Color Talk

● Chicago

In speaking on the subject of "Color Vision" at the Oct. 23 meeting of the Chicago Section, H. T. Strong of William Wiese & Co., recalled the early days of the automotive industry, when blended color schemes for automobiles were just beginning to get a start. Most of his talk and demonstration, however, were devoted to the use of polarized light in visualizing normally invisible colors in mineral, vegetable and animal substances including such things as asparagus juice, turpin hydrate, methane, chlorate of potash, trianol, primol, oak and horsehair.

The lecture closed with a demonstration during which the audience was permitted to see on a screen crystalization of a chemical which had been reduced to a fluid state under its eyes.

The meeting, which was held at the Medinah Club in Chicago was attended by 128; dinner preceding the meeting was attended by 107.

Roos Shows Status Of Recent Design

●Canadian

The small, average automobile has gone a long way to oust the big, luxurious car from the market and is here to stay, at least for the next few years. This was the keynote in a talk by D. G. Roos, president of the Society and chief engineer, Studebaker Corp., at the Oct. 17 meeting of the Canadian Section, held at the Royal York Hotel, Toronto. Mr. Roos was accompanied on his trip to the Section by John A. C. Warner, secretary and general manager of the Society. More than a hundred members and guests turned out for the meeting. R. H. Combs, president and general manager, Prest-O-Lite Storage Battery Co. Ltd., known as the "daddy" of the Canadian Section, was host to its members and guests.

Mr. Roos' message covered the present stage of engineering development on the various components which make up an automobile.

"Since people tightened their purse strings four or five years ago," he said, "engineering has jumped the efficiency of the small car to an enormous extent. Former owners of large cars have found in the smaller one, with its lower initial cost and maintenance, reliable, efficient service to meet all needs.

"Price is still a governing factor," said Mr. Roos, and pointed out that the automobile industry in the United States will pay in taxes this year a million dollars more than its capital investment.

Reduction in car weight from 42 to 43 lb. per hp. to approximately 30 lb. per hp. has followed the discovery by automobile manufacturers that people are not prepared to pay for expensive, radical changes. Engines have been developed which turn up to 4500 r.p.m. and which use up to 22 per cent less fuel than the average car of a year or so ago.

Mr. Roos gave as his opinion that there was

little likelihood at the present time that speeds would be increased. Such increase, he felt, would result in a larger engine displacement and a heavier all-round car—things which are not economic at the present time.

Among the developments now being worked upon by engineers he mentioned the automatic overdrive, the automatic transmission and independent suspension for four wheels. At the present stage of development, he believes, all these items would be impracticable on an inexpensive light-weight automobile.

Regarding engines in the rear, he said that owing to the complications involved they were not likely to be used in production unless some tangible gain could be shown in the performance of the car.

Mr. Warner presented to the Section some remarks on the increase in membership and standing of the Society as a whole, with some sidelights on the development of the Canadian Section.

Rise of Streamlining Traced by R. H. Heald

• Baltimore

"The Evolution of Streamlining of the Automobile—Its Development and Future Possibilities" was presented at the Nov. 1 meeting of the Baltimore Section by R. H. Heald of the aerodynamic division, National Bureau of Standards.

Mr. Heald went back to the early 1900's in his discussion of the origin of streamlining, and brought to light many photographs of early automobiles designed in some kind of accord with the streamlining idea.

Wind-tunnel tests, and other work conducted for American automobile manufacturers by the National Bureau of Standards, were explained in some detail, but Mr. Heald would not give any prediction of the future of the design which as he said, has made the average American motorist "air-conscious."

Members and guests of the Section who attended the dinner preceding the meeting were entertained with 15 minutes of magic, displayed by Vin Carey, a widely-known sleight-of-hand artist. Dinner attendance was 31, with about 25 more persons turning out for the meeting itself.

Rippie and Haizlip On Petroleum, Flight

• St. Louis

The production, transportation, development, testing and use of the products of crude petroleum were presented in motion pictures and speech at the Oct. 10 meeting of the St. Louis Section. The speaker was Dr. C. W. Rippie, special representative of the manufacturing department, Shell Petroleum Corp.

Capt. James G. Haizlip, Shell Petroleum Corp., followed Dr. Rippie on the program with some reminiscences of airplane flights, particularly of his record-breaking flight from Los Angeles to New York, during the National Air Races in 1932.

A letter from George P. Dorris to S.A.E. headquarters gives some sidelights on the meeting from the point of view of a Society and Section member of long standing. Of Captain Haizlip's talk, Mr. Dorris writes: "It was so full of the human equation, in such rapid-fire description of changing conditions during a flight, that one literally rode every foot of the way with him".

Of Dr. Rippie's presentation, Mr. Dorris writes that it was instructive and educational, and that among the things discussed was the relative value of different distillates and their behavior in gasoline engines. The St. Louis meeting was attended by 37 members and guests. Instead of a dinner preceding the meeting, there was a Dutch lunch to follow. The innovation was welcomed by those present.

Elliott on Racing; Criswell on Alaska

• So. California

Ordinarily, more about new developments in tires, steering, balance, ignition, engine design, fuels, etc., can be found out in a few hours on the race track than in months of road testing, according to Frank Elliott, Ethyl Gasoline Corp., who spoke on the "History of Racing and Fuel Development" at the Nov. 9 meeting of the Southern California Section.

In the early days of racing, Mr. Elliott pointed out, most of the cars participating were rebuilt stock cars equipped with higher rear-axle ratios to increase their top speed but acceleration, then, as now, was a very important factor in winning races so that to stay in the competition engines had to be "souped up."

In his paper, Mr. Elliott presented a table showing some characteristics of the winning car in the Indianapolis races from 1911 to 1934.

With the drop in piston displacement limits in 1920, he pointed out, it became necessary to turn out very high horsepower with a very small engine and the easiest way to accomplish this was to turn the engine up to a higher speed. After some discussion of the consequences of this, Mr. Elliott concluded that "the four-cylinder engine which won the 1934 race could not have been built up to do a necessary 104 m.p.h. in 1920 because the necessary materials and details of design were unknown at that time."

In addition to the paper by Mr. Elliott, the Section heard Lynn Criswell of the Alaskan Steamship Co., who presented with his talk three reels of motion pictures of views in Southeastern Alaska.

Guests at the meeting included Louis Meyer, noted racing driver, who was prevailed upon to tell some of his experiences on the racing track. Another guest was George H. Mosel, chairman, Northern California Section, who gave a brief talk in which he urged more get-together meetings of the Northern and Southern California Sections.

Discussers of Mr. Elliott's paper included: H. A. Nichols, Northrop Co.; C. H. Jacobsen, Dept. of Water & Power; R. N. Reinhard, Western Dairy Products; W. S. Smith, Wilshire Oil Co.; Lt. Baldwin, U. S. Army; C. T. Austin, Lockheed Aircraft Co.; C. F. Lienesch, Union Oil Co.; W. Linville, Los Angeles County.

Truck Tax Burden Scored by Staehli

• Oregon

Many large trucks are paying more than $3000 a year in tax and license fees, Ralph J. Staehli, manager, Allied Truck Operators, brought out at the Oct. 12 meeting of the Oregon Section. Mr. Staehli's subject was "Truck Legislation, Taxation and Licensing". He spent considerable time in developing the effect of the tremendous tax burden on the truck industry.

Lawrence J. Grunder, lubrication engineer, Richfield Oil Co., also spoke, covering lubrication with respect to different conditions of engine operation. Particularly he dwelt on the advisability of using recommended grades of S.A.E. lubricants, pointing out that the oil temperature could be considerably reduced in many cases by such a selection. He advanced the opinion that detonation occurs in alloy cylinder heads as in iron heads but that alloy heads absorb the noise without stopping the pinging or detonation.

Attendance at the meeting was 47.

Tractor Meeting

December 5 and 6, 1934
Stevens Hotel—Chicago

Open to all S.A.E. members and their friends who are interested in tractor, agricultural and industrial-power equipment subjects. General theme of the meeting: Wear Factors in Engine Design.

For details of program see November issue of the S.A.E. JOURNAL.

Taylor Describes Rise of Automobiles

• Washington

Frank A. Taylor, curator of the Division of Engineering, U. S. National Museum, discussed the various stages in the development of the automobile before a group of 25 members and guests of the Washington Section at a meeting held Nov. 7, following a dinner at the University Club.

Mr. Taylor presented a great number of slides of early cars, models, and engines, going way back before the time the horseless carriages, familiar to most older people, had appeared. Some of the early English steam carriages were shown, and one model boasted a crude device intended to provide some degree of power steering. The front truck carried a shaft, the front end thereof being supported on a pilot truck whose smaller wheels could be easily steered to right or left, resulting in lateral movement of the shaft as they moved across the road.

Slides of the early models, with their huge tops and peculiar seating arrangements, brought many laughs. Some old racing cars, such as Alexander Winton's 8-cylinder "Bullet", were pictured.

After the meeting, Mr. Taylor reversed the usual procedure somewhat and invited suggestions on how the Museum's collections might be improved or added to, with respect to automotive equipment. Dr. H. C. Dickinson, past president of the Society, suggested that an exhibit be set up to illustrate the scientific devel-

opment of the modern pneumatic tire, which has contributed so much to the comfort, safety and speed of the modern car. He suggested that the exhibit be presented in the form of thin sections of tires representing the various steps in their development, thus conserving space in the Museum.

Says Massachusetts Fits Roads to Use

● New England

Some drivers who use the highways believe that little, if any, thought in their design is devoted to the driver's comfort or traffic problems. This was brought out at a New England Section Meeting on Oct. 9 by Clarence P. Taylor, traffic engineer, Massachusetts Department of Public Works, who devoted much of his paper to refuting the opinion expressed in the first paragraph.

The second speaker at the meeting was Frank E. H. Johnson, general service manager, Noyes Buick Co., Boston, who discussed "Vacuum Control of Ignition Timing", using a series of slides to illustrate his points and speaking principally from notes.

Mr. Taylor, whose subject was "Fitting the Highway to Traffic", pointed out that in Massachusetts, from 1909 to 1933, vehicular traffic had increased 1400 per cent. Each stage of this increase, he said, had made necessary changes in the objective of highway planning, until the trunk highway of today includes a number of by-passes inserted to make possible avoidance of urban traffic conditions. This is in distinction to earlier highway construction which had as its objective only direct connection of population centers.

"Rear Engines" —Topic of Two

● Southern California

Speaking from notes, Rolla W. Moore, General Motors Truck Division, described "Rear-Engine Mountings" at the Oct. 12 meeting of the Southern California Section. Views on the same subject were contributed by Fred C. Patton, assistant manager, Los Angeles Motor Coach Co. Frank R. Elliot, Charles H. Paxton, J. Miller and D. Hall participated in the discussion, after which the meeting adjourned to view a rear-engined coach displayed by the Los Angeles Railway.

Attendance at the dinner preceding the meeting was 74, with a total attendance of 102 to hear the talks.

Leaf-Spring Paper Gets Second Hearing

● Cleveland

Members and guests of the Cleveland Section to the number of 105 turned out on Nov. 12 to hear J. H. Shoemaker, code commissioner, Leaf Spring Industry, and Karl K. Probst, consulting engineer, Leaf Spring Institute, describe the details of the experimental car developed by the institute. Virtually the same program was presented at the Oct. 2 meeting of the Pittsburgh Section, of which an account will be found on p. 23 of the November issue of the JOURNAL.

The Cleveland meeting was preceded by a dinner attended by 50 members and guests; the meeting itself was followed by general discussion in which a large number of those present participated.

Research Must "Dig Deeper" In Future, Says T. A. Boyd

● Syracuse

In automotive progress, the stage has now been reached at which most of the easy developments have been accomplished, according to T. A. Boyd, research division, General Motors Corp., who was the speaker at the Oct. 29 meeting of the Syracuse Section.

The program was arranged to include members of the Technology Club of Syracuse, which resulted in an attendance of more than 200 members and guests of the Section.

The full text of Mr. Boyd's paper is not available but a summary prepared by him follows:

"Research has been more than a mere help to the motor car. If it had not been for the intelligent form of experimentation which is called research for short there would have been no automobile in the first place. It was as a consequence of the slow evolution which resulted from spasmodic research along many lines—mechanical, chemical, physical, metallurgical—that during the years just before and after 1890 several men were busily striving to give reality to the age-old dream of a horseless carriage.

"Likewise, all of the marvelous advancement which has been made over the crude and unreliable vehicle that those men then produced has been made through the agency of research of some kind. Haphazard and spasmodic invention was early superseded in the motor car business by continuous, organized experimentation. This is why the motor car has been developed so quickly into the beautiful and dependable vehicle which it now is. It is also why today people pay only 20 cents a pound for cars in the lower-price brackets, where not long ago they had to pay 50 cents.

"Nevertheless, most stories about the advancement of the automobile imply that, like Topsy, each improvement just 'growed' of its own accord. They pass over without mention all the toil, the headaches, the troubles, the discouragements—not to say the expense—that went along with the experimentation which brought each new thing into being. They fail as well to mention the manifold difficulties, delays, and disappointments which must always be passed through in selling any new idea to others. They thus leave altogether out of account the fact that always 'the price of progress is trouble.'

"Not all the immense amount of effort which has been put on improving cars has been or is being expended directly within the automobile industry itself by any means. There has perhaps never been a greater borrower from other fields of endeavor than the automobile industry. Of the many, many materials through which research outside the automobile industry proper has been making a large contribution to the motor car, rubber may be mentioned in illustration. Twenty-five years ago a rubber tire for a car of small size cost about $30, and the purchaser thought he was lucky if it ran 5000 miles. Today a tire in the same class costs less than $10, tax included; and, if it does not run 15,000 miles, the purchaser thinks he has a just complaint to make. Thus it is that, thanks to constant research, the cost of automobile tires per mile of driving has been divided by 10.

"I once tried to make a list of the chemical and metallurgical materials which are used directly or indirectly in the automobile industry. I did not find them all, but had no difficulty in naming more than 225 different products. Think of all the research that is done by the makers of these many materials, the results of which are being passed on in some measure to the motor car manufacturer and user. Of the nearly 1600 industrial research laboratories in the United States, as listed by the National Research Council in 1932, about 450, or more than one-fourth of them, are either those few directly within the automobile industry itself or those many which are maintained by suppliers of automotive materials.

"The stage has now been reached at which most of the easy developments have already been made. And so it has become necessary nowadays to dig deeper and deeper for those further improvements which are really worth while. Thus it is that the industry has had gradually to turn from the rudimentary or tinkering type of experimentation to the pioneering form of research, or to what amounts in some instances to digging down into the fields of the fundamental sciences.

"And it is for this reason that those who now are trying to improve automotive transportation still further have come to consist not only, as at first, of conventional engineers. It is why they now include as well men who are capable of conducting pioneering researches in such sciences as chemistry, physics, and mathematics—and even as botany and bacteriology. But, of course, the work of these pioneering investigators is naturally supplementary to that of automotive engineers and practical experimental men."

Over-Drive Program Repeated By Speakers

● Indiana

Added economy, power at higher speeds and comfort in riding were some of the results attributed to use of the over-drive in passenger-car transmissions by W. B. Barnes, Barnes Motor Development Co., Indianapolis, and S. O. White, chief engineer, Warner Gear Co., who read a two-part paper on the "Automatic Over-Drive for Passenger Cars" at the Nov. 8 meeting of the Indiana Section. A brief digest of the paper had been presented previously by Mr. Barnes at the Nov. 6 meeting of the Pittsburgh Section. Lee Oldfield, consulting engineer, Merz Engineering Co., Indianapolis, repeated his observations on over-drive performance which had been given on the same Pittsburgh program on which Mr. Barnes spoke.

In presenting his section of the paper, Mr. Barnes paid high tribute to Mr. White, who with his staff had assisted in the development of the gears making possible the over-drive principle.

Mr. White devoted his portion of the paper to tracing the history of the over-drive principle and explained its working parts with slides.

Arthur W. S. Herrington, chairman of the Indiana Section, spoke of the almost universal adoption of the over-drive principle in Europe where high taxation and fuel costs force engineers to seek every possible increase in mileage from a given design of car. Col. Herrington's remarks were based on a European trip from which he has recently returned.

Attendance at Indiana's November meeting reached 208 members and guests with 60 participating in the dinner which preceded the meeting.

Section Has Busy October Meeting

● No. California

A wide range of interests was covered by several speakers at the Oct. 9 meeting of the Northern California Section, held in San Francisco.

The meeting opened with a roll-call, during which each man present introduced to the meeting the person who was sitting to his left. After this ceremony, Chairman Mosel announced that Major Edwin C. Wood, superintendent of transportation in the San Francisco division of the Pacific Gas & Electric Co., would be in charge of the Dec. 14 meeting of the Section, which would include a dinner-dance and holiday jinks of an interesting character. Several motion-picture stars have been invited to attend the December meeting, and a general attendance of 300 couples is anticipated for the event.

Following this announcement, Col. B. J. Arnold, of Chicago, gave a brief history of how the S.A.E., in its present organization, came to be formed.

The next speaker was Joseph F. Long, vice-chairman of the Section, who outlined aeronautic activities in the Bay district, and how the Northern California Section could participate in them.

Mr. Long was followed on the program by R. D. Bedinger, supervising inspector, 8th Inspection District, Bureau of Air Commerce. Mr. Bedinger took as his theme "Safety and Procedure in the Air." Part of his talk described the process by which airplanes are licensed and receive approved-type certificates from the Bureau of Air Commerce in Washington.

Next on the program were Messrs. Veale and Holman, the first discussing the projected handling of vehicular traffic on the new San Francisco-Oakland Bay bridge, and the second with a resume of recent changes in motor-truck design and transportation.

J. H. Wythe, assistant general manager, Pacific Motor Truck Co., gave a paper concerned with practice in the store-door delivery field, pointing out that the frequency of shipments is increasing because orders are small in these times, and the stores are therefore not willing to carry large stocks of a particular item.

Brief talks by Messrs. Rice and Patch wound up the meeting. Mr. Rice presented some figures showing how bus operations have built up tremendous mileages without time out for breakdowns, while Mr. Patch told some features of the new "pancake" engines.

Sidney B. Shaw, chairman of the Section's placement committee, asked the cooperation of other members in placing opportunities before those members who are without employment. The meeting was attended by 92 members and guests with 76 at the dinner.

Alaskan Flight Story Draws Large Meeting

● Detroit

THE "Army Alaskan Flight" and "Problems in the Development of a High-Speed Engine" were the major topics which attracted some 300 to the combined Aeronautic and Passenger Car Activity meeting of the Detroit Section Nov. 5. Rated as one of the most successful meetings in recent years from the point of view of interest, Major Ralph Royce, Commandant at Selfridge Field, who discussed the first topic, and Stanwood W. Sparrow, of the Research Department, Studebaker Corp., who talked on the latter, held the attention of their audience until close to midnight.

In addition a treat was offered the Section in the shape of short addresses by Mr. and Mrs. Jean Piccard, of recent Stratosphere flight fame, who were guests of the Section for the evening.

Particularly interesting in Mr. Sparrow's paper were his comments on the effect of various engine parts of increases in speed and attempts to increase power. In addition to the routine opening up of engine breathing ability the attempts to increase power ran into such investigations as proper manifolding tuning, to take maximum advantage of manifold pulsations, selection of the proper type of ignition system, effect of and control of piston blow-by, etc.

Some random notes on this paper include the following: The effectiveness of an ignition system can be checked by testing it on a new engine with the gaps set at 0.050 in.

Tests resulting from troubles demonstrated the necessity of keeping spark-plug leads well separated from coil wires to distributor.

In the Studebaker investigations, the lowest compression ring usually failed before the upper rings. This was credited to blow-by at high speeds, and Mr. Sparrow anticipated that results probably might not be duplicated in actual service operation.

Expander rings were found to reduce blow-by materially, probably by doing one or both of two things: keeping the piston straight and maintaining ring contact with cylinder wall.

Both of these factors are vitally important in controlling oil consumption at high speeds. Mr. Sparrow was of the opinion that oil consumption due to burning of oil on cylinder walls was a more important factor at high speeds than generally considered.

Cracks forming in the cylinder block at the valve ports, either between the ports, or between port and cylinder bore, were definitely traced to detonation or pre-ignition as a cause. Such cracks could be reproduced at will in only a few minutes running time under pre-ignition conditions. The cracks were determined to be tensile failures during cooling following rapid expansion of the block during the high temperature periods occurring during detonation.

Large diameter valve stems were found to help materially in reducing valve pounding, attributed to ability to carry the heat away better.

Scoring of cylinder bores was found to be frequently not due to clearance considerations, but to lack of adequate oil film, with this film at the top of the bore possibly being burned away at the high temperatures encountered.

Cylindrical milling of stud bosses of big ends was found to reduce connecting-rod failure.

Copper lead bearings were found to be of great value in increasing reliability of bearings.

Major Royce, in addition to a highly interesting account of events during the recent U. S. Army experimental and mapping flight to Alaska, recited some pertinent information as to performance of the planes. The latter were Martin center-wing bombers, equipped with Cyclone engines. All 12 planes which left on the flight returned. The flight started without any extensive previous service testing of the equipment, an interesting commentary on the reliability of these planes.

Top speed of the equipment was rated at 210 m.p.h., with a landing speed of around 80. Fuel capacity of each ship was 452 gal., in four tanks, with a consumption of 60-70 gal. per hour for the plane. The ships, with the maximum load carried, were found capable of climbing on one engine.

The flight personnel consisted of only 38 men including the flight and service personnel. During the flight, the flight-commander's ship was able at all times to keep in touch by two-way radio with both the station behind and the station ahead. One hop was 960 miles in length, between Juneau, Alaska, and Seattle, Wash.

Due to the lack of servicing equipment available along the route ships were equipped in the nose with hand operated wabble pumps by means of which each ship could be gassed, oiled, and lubricated at each stop in less than an hour, without requiring extensive ground equipment for servicing.

With the staff available, one of these land planes, which landed in the water in Alaska due to a switch to an empty gasoline tank, and was obviously damaged as a result, was repaired in six days by six mechanics.

Major Royce was introduced by Professor Altman, vice-chairman in charge of the aeronautic activity in Detroit, and Mr. Sparrow by Earl H. Smith, vice-chairman of the passenger-car activity of the Section. Clyde R. Paton, chief engineer of Packard, and Detroit Section chairman, presided.

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Representatives of the S.A.E. on the Sectional Committee which prepared the revised standard were: Arthur Boor, chief engineer, Monroe Auto Equipment Co.; Earle Buckingham, professor of engineering standards and measurement, Massachusetts Institute of Technology; George S. Case, president, Lamson & Sessions Co.; Edwin H. Ehrman, chief engineer, Standard Screw Co.; and Oliver B. Zimmerman, Johnson & Co.

Barnes and Oldfield Share a Meeting Spot

• Pittsburgh

Procedure of the American Automobile Association Contest Board in making performance tests for motor-vehicle manufacturers was described by Lee Oldfield, Merz Engineering Co., Indianapolis, at the Nov. 6 meeting of the Pittsburgh Section. Mr. Oldfield's paper which was titled "Automotive Performance" was supplemented by a talk on over-drive mechanisms by William B. Barnes, of the Barnes Motor Development Co. Mr. Barnes' talk was a brief digest of a paper prepared jointly by him and S. O. White, Warner Gear Co., for presentation at the November meeting of the Indiana Section.

J. B. Fisher Describes "Forty-Wheel Brakes"

• Milwaukee

"Forty-Wheel Brakes—Their Design, Operation and Adjustment" was the subject presented by J. B. Fisher, which startled more than a hundred members and guests who turned out for the Oct. 3 meeting of the Milwaukee Section held in Waukesha. Mr. Fisher, who is chief engineer, Waukesha Motor Co. and a Councilor of the Society, did not, of course, stick literally to the announced subject. Instead he presented what was characterized as a "rare treat" in a philosophical discussion which might be summed up in the phrase "always be open-minded."

The forty-wheel brakes to which he devoted his attention were those brakes to progress that are built up in men's minds and by men's prejudices and preconceived notions which are invariably expressed by a recoil from new ideas advanced in any field. "None of us," said Mr. Fisher, "are exceptions when it comes to building these brakes. In fact, all of us in our waking hours are busy building them for our own private use or improving some pet brakes of our own design, or criticizing the brake performance of our fellow workers. Their action is not always detrimental; it is the ability to use them wisely and promptly, and to release them when needed that discloses a man who has mastered one of the finer arts of living."

Among the particularly vicious types of brakes that are quick-acting, difficult to release, and exceedingly popular, is the prejudice brake, Mr. Fisher pointed out.

General Manager John A. C. Warner was present and discussed points of Mr. Fisher's paper by drawing several examples from the experiences of Benjamin Franklin. Following the discussion and announcement of the next meeting, refreshments were served.

Two Brake Papers Share A Program

• Northwest

"To my mind the ability of the air brake to control trucks and to bring them quickly and safely to a stop is far more important than the operations required to impart motion," said Ralph K. Whittlesey, Bendix-Westinghouse Automotive Air Brake Co., who spoke on "Automotive Air Brakes" at the Nov. 9 meeting of the Northwest Section. Mr. Whittlesey's paper was followed by one on "Mechanics of the Brake Show Assembly" by George E. Bock. Mr. Bock's talk was mathematical in nature, with liberal use of the blackboard and chart. Equations were introduced showing stopping distance of vehicles of certain weights and speeds when retardation is applied through the braking system.

Because of the fact that when vehicle wheels are locked, the stopping distance depends only on speed and the highway coefficient of friction, Mr. Bock advised that brakes should not be too powerful, leaving the wheel-locking possibility as far as possible out of range.

Mr. Whittlesey gave a detailed description of the automotive air brake and some of its recent developments. One of the newer developments, he said, was a second brake valve hand-operated which actuates trailer brakes independently of the truck brakes. According to Mr. Whittlesey, the Westinghouse brake produces an average maximum retarding force of 3500 lb. per drum, or 14,000 lb. for the whole vehicle equipped with four drums.

The meeting was held at the Hotel Gowman in Seattle and was attended by 57 members and guests of whom 35 attended the dinner preceding the meeting.

Among those who participated in discussion of the two papers were: C. H. Bolin, Pacific Telephone & Telegraph Co.; S. W. Bushnell, The Automotive Engineering Co.; W. W. Churchill, Washington Motor Coach Co.; J. G. Holmstrom, Kenworth Motor Truck Co.; and H. A. Reinhart, Ethyl Gasoline Corp.

Members Inspect Overhaul Shops

• Milwaukee

The Milwaukee Section turned out in force for the Nov. 7 meeting, some 150 members and guests enjoying the hospitality of the Milwaukee Electric Railway and Light Co. at its Cold Spring Shops.

J. H. Lucas, assistant to the president of the company and superintendent of rolling stock, opened the meeting with a series of slides and maps picturing the development in street-car types and the moves made by this progressive utility to meet the changing conditions in transportation occasioned by the increasing use of private automobiles. We were given a glimpse of the car of the future which may result from the President's conference on transportation—a new type in which special attention has been given to the elimination of noise.

Henry S. Debbink, former Section chairman and superintendent of maintenance on gasoline vehicles, presented the technical paper of the evening, "Factors Affecting Gasoline and Oil Consumption." Accurate statistical records maintained since the inception of bus service by the company were shown graphically.

F. C. Patton Requests Withdrawal of His Name as Nominee

In the October issue of the S.A.E. Journal (p. 21) was published the list of nominees for officers of the Society for 1935 as proposed by the regular nominating committees.

In the November issue (p. 24) was published the additional nomination of Fred C. Patton for Vice-President of the Transportation and Maintenance Activity, his nomination having been proposed by a special nominating committee organized in accordance with the provisions of Paragraph C 47 of the Constitution and Paragraph B 27 of the By-Laws of the Society.

After the mailing to the membership of the ballots for election of officers for 1935, the following letter was received by the Secretary:

Nov. 7, 1934

My dear Mr. Warner:

The ballot just received from your office for election of officers for the Society for the year 1935 carries the names of both Mr. T. C. Smith, New York City, and myself as opposing nominees for the office of Vice-President, Transportation and Maintenance Engineering.

While I greatly appreciate the honor of being nominated for this national office, I believe that the best interests of the Society require the unanimous election of Mr. Smith, and, therefore, desire at this time to withdraw my name from the list of nominations in his favor. I also wish at this time to tender him my full and whole-hearted support.

I shall appreciate having my withdrawal brought to the attention of the members in the next issue of the S.A.E. Journal.

With best regards, I am

Cordially yours,
Fred C. Patton.

A High-Power Spark-Ignition Fuel-Injection Engine

By Torbjorn Dillstrom
Hesselman Motor Corp., Sweden

THERE has, for many years, been a demand for an automotive engine more economical in operation than the gasoline engine. As the Diesel engine had early established a good reputation for economy, the development work on a more economical automotive engine quite naturally centered around this type of engine.

Additional advantages can, however, be gained by combining fuel injection with spark ignition, and an engine of this type has been developed by K. J. E. Hesselman of Stockholm, Sweden. This engine is generally called the Hesselman engine.

In the spark-ignition fuel-injection engine the charge is formed at a certain time before the spark occurs, and this makes it possible to mix fuel and air thoroughly whereby high output is secured. Engines operating on fuel oil with a compression ratio of 7.5 : 1 have given a brake mean effective pressure of over 125 lb. per. sq. in.

The fuel is not injected until at the end of the compression stroke, and thus is not unduly heated by the heat of compression. A higher compression-ratio can therefore be employed in this engine than in the carburetor engine without preignition or detonation. The engine thus works in an efficient cycle.

ALTHOUGH the gasoline engine is a wonderful powerplant for trucks, buses and other vehicles, for many years there has been a demand for an engine more economical in operation. Such an engine should have low fuel-consumption and also should be able to utilize a wide variety of fuels, so that the fuel which is at the moment the cheapest in any given locality can be used. Economy, however, is not the only requirement of such an engine, for, to be able to compete successfully with the gasoline engine, it must approximate the general performance characteristics of this engine. Consequently, high power, high speed and smooth operation are necessary.

Since the large Diesel engine had already made for itself a good reputation for fuel economy and reliability, it naturally followed that attempts were made to adapt the Diesel engine for automotive purposes, and the early development work on a more economical automotive engine centered around the Diesel type. For those who had been in the center of the development work on the solid or airless-injection engine, it was, however, apparent that the Diesel cycle did not lend itself as well to high-speed engines of small size as to the low-speed types of large size.

One of the first to succeed in making a commercially successful airless-injection engine was K. J. E. Hesselman, and the research work on combustion chambers, ignition characteristics of fuel and the like, that was carried out in connection with the development of the Hesselman airless-injection Diesel-engine, showed that, although without doubt it was possible to develop a high-speed compression-ignition engine of small size, additional advantages could be gained by employing a different principle of charge-forming and burning. By combining pump injection of fuel with electric ignition, it was found that an engine could be built with performance characteristics that neither the carburetor engine nor the compression-ignition engine could obtain on account of their inherent principles of operation.

The first trials with electric ignition were, in fact, made before the Diesel engine was invented; but, in those days, both the ignition devices and the knowledge of the principles of fuel injection were primitive. A renewed study of the problem in the light of knowledge obtained through the development work on the airless-injection engine showed, however, that an injection engine with spark ignition could fill an important place at the side of the carburetor engine and the compression-ignition engine. The development work on such an engine was therefore undertaken, and has led to the development of the special type of engine known as the Hesselman engine.

In the following discussion I will first give a short description of the Hesselman engine, and will thereafter show how this new type of engine differs in principle from other types of internal-combustion engines.

[This paper was presented at the Semi-Annual Meeting of the Society, Saranac Inn, N. Y., June 20, 1934.]

The working principle of the engine is as follows: The air for combustion enters the cylinder in tangential direction during the suction stroke. The air is thus caused to rotate around the axis of the cylinder, and the rotating movement continues during the compression stroke. At the end of the compression stroke fuel is injected by the fuel pump. At full load, the injection begins 50 to 60 deg. ahead of top dead-center and ends about 25 to 30 deg. ahead of top dead-center. The rate of fuel injection and the speed of air rotation are so related that, at full load, the fuel is evenly distributed throughout the whole combustion chamber. When idling, however, only a part of the rotating air is charged with fuel. In this way there is formed in the combustion chamber a cloud of fuel fog, which is caused to pass the spark plug by the rotating movement of the charge. The ignition is so timed that the spark occurs as the fuel cloud passes the plug.

Fig. 1 shows the location of the injection nozzle and the spark plug relative to each other. To prevent fuel from striking the cold cylinder walls, the piston is provided with a collar extending above the piston head. Any fuel crossing the combustion chamber strikes this collar. In this way dilution of the lubricating oil is prevented.

Figs. 2 and 3 show details of the injection nozzle. Inside of the nozzle holes, larger cylindrical holes are provided which the oil enters tangentially through a V-shaped channel. The oil is given high rotative velocity in these inner holes, and the tangential-speed component gives the desired distribution of the fuel in the jet.

It has been found necessary for satisfactory operation to throttle the air admitted when the engine idles, and also when it is run below a certain load. This throttling of the air is accomplished by means of a throttle valve similar to the kind used on a gasoline engine. Depending upon the position of the throttle valve, a certain vacuum will be formed in the engine manifold. This vacuum acts upon a vacuum governor of the kind shown diagrammatically in Fig. 4.

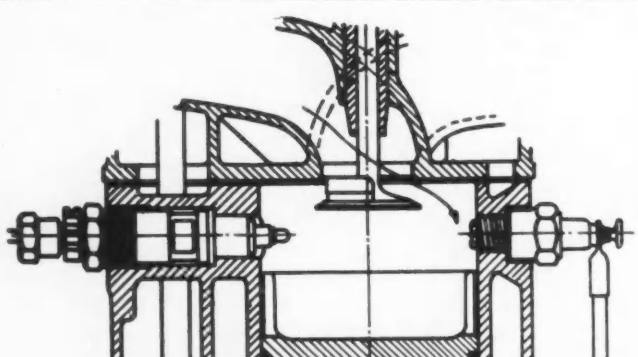


Fig. 1—Relative Location of the Injection Nozzle and the Spark Plug

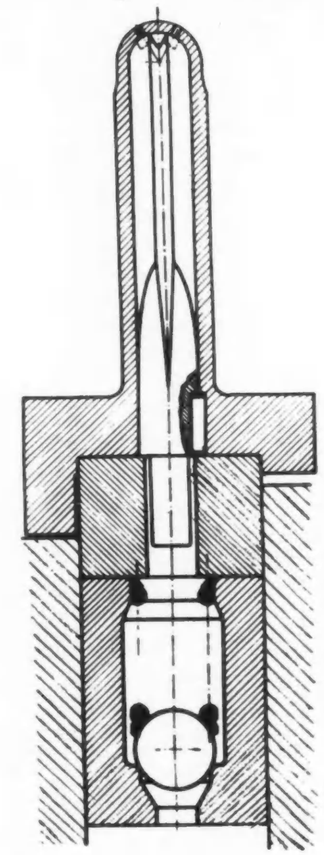


Fig. 2—Details of the Injection Nozzle

The vacuum governor consists of a cylinder and a spring-loaded piston, the spring-loaded side of which is exposed to the vacuum and the other side of which is exposed to atmospheric pressure. The piston thus takes a position always corresponding to the degree of vacuum in the manifold. The piston is connected to the control rod of the fuel pump, and in this way it is possible to obtain a certain relation between the vacuum in the manifold and the quantity of fuel injected. The vacuum governor also fulfils another function in addition to giving the proper fuel-air ratio. It works as a speed stabilizer. If, for example, the engine, idling, with the throttle valve in a given position, should tend to slow down in speed, the vacuum in the manifold decreases. As soon as the vacuum decreases the springs move the piston of the governor, and the quantity of fuel injected by the pump is increased. This counteracts the drop in speed, and the governor thus acts as a speed stabilizer. On light truck engines or marine engines, where no overspeed governor is required, the fuel pump is controlled solely by this simple vacuum governor.

The foregoing briefly describes the principle of the Hesselman engine, and I will now discuss some of the reasons which have led to the development of this type of engine.

Let us first consider the questions of power and economy, which are mainly dependent upon the following factors:

(1) Theoretical efficiency of the cycle on which the engine operates
(2) Mechanical efficiency
(3) Efficiency with which the air is utilized
(4) Heat loss during the working stroke.

The efficiency for an ideal engine working on the Otto cycle varies with the expansion ratio according to the following formula:

$$\mu = \left(1 - \left(\frac{1}{r}\right)\right)^{\gamma - 1} \qquad (1)$$

This efficiency is generally called the air-standard efficiency. This name, although generally adopted, is somewhat misleading, since a perfect gas, and not air, must be used in the ideal engine.

Curve *A* in Fig. 5 gives the values of the air-standard efficiency for different expansion ratios using the value of $\gamma = 1.396$. The air cycle assumes that heat is supplied at constant volume when the piston is at top dead-center. For the highest compression ratios, such a cycle would lead to terrific maximum pressures and it is therefore necessary to limit the pressures. This is done by supplying only part of the heat at top dead-center and the rest of it after the gases have been partially expanded. This, however, changes the efficiency of the cycle, as the expansion ratio no longer is the same as the compression ratio.

Let us take a pressure of 1000 lb. per sq. in. as the maximum limit. A ratio of 10:1 is then the highest compression ratio at which all of the heat can be added at constant volume. For each ratio above 10:1, less and less heat can be added at constant volume, the remainder being added at a constant pressure of 1000 lb. per sq. in.

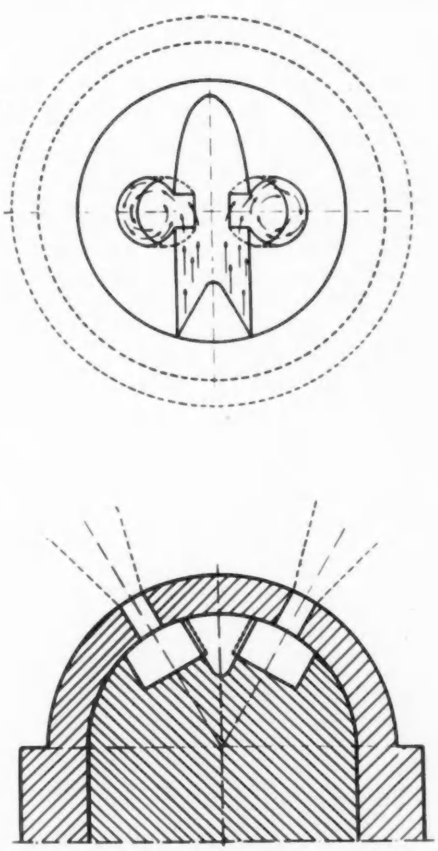


Fig. 3—Further Details of the Injection Nozzle

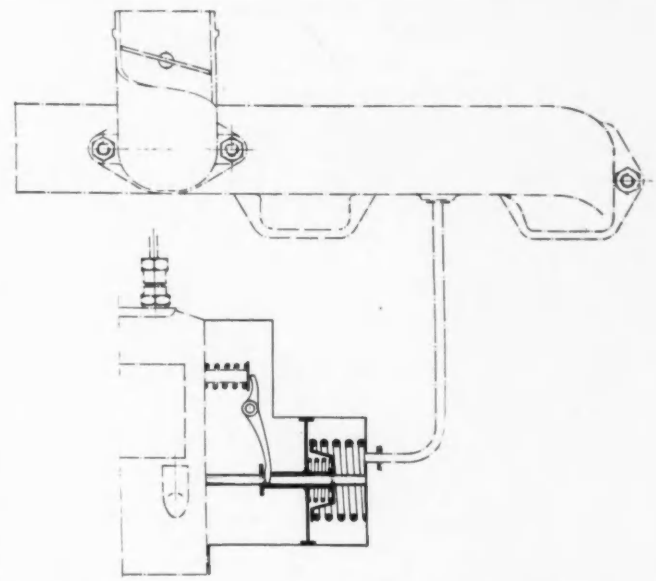


Fig. 4—Diagrammatic Sketch of a Vacuum Governor

Curve *B* of Fig. 5 shows the resulting efficiency from this composite cycle. The ideal air cycle as well as this composite cycle, assuming ideal gas, is of course far removed from practical possibilities. For comparison of real engines, a cycle that is of more value is one based on the properties of the working substance actually used and simplified only by the assumptions that the heat is transmitted instantaneously to the working substance and that there is no loss of heat through the walls of the combustion chamber.

Pye gives, in his book "The Internal-Combustion Engine", the curve for the efficiency of a 20 per cent weak mixture. This curve, as indicated at *C* in Fig. 5, is based on the actual working substance and is calculated from the most accurate data available for calorific values and volumetric heats and the known behavior of CO_2 and water with respect to dissociation at high temperatures. Pye has also corrected this cycle for a limited maximum pressure. In this case the limit is 915 lb. per sq. in.

Curve *D* of Fig. 5 shows the efficiency of this cycle. This curve thus represents an approachable though not an obtainable ideal for an internal-combustion engine working with reasonable maximum pressures. The curve is interesting in that it shows that practically no gain in efficiency is obtained by increasing the compression ratio over 14:1 or 15:1. At 10:1 the efficiency is 48 per cent and at 15:1 it is 50.8 per cent. It can be shown that a further increase of the ratio to 20:1 is almost entirely without influence on the efficiency, which rises to only 51.3 per cent at this ratio.

The efficiencies referred to are all indicated efficiencies. The picture is not complete without taking into account the mechanical losses. The economy, as well as the power, is dependent on the engine friction. On account of its heavier reciprocating parts, high compression and maximum pressures and large number of piston rings, the mechanical efficiency of the compression-ignition engine is relatively low. It is very difficult to measure exactly the friction of a high-

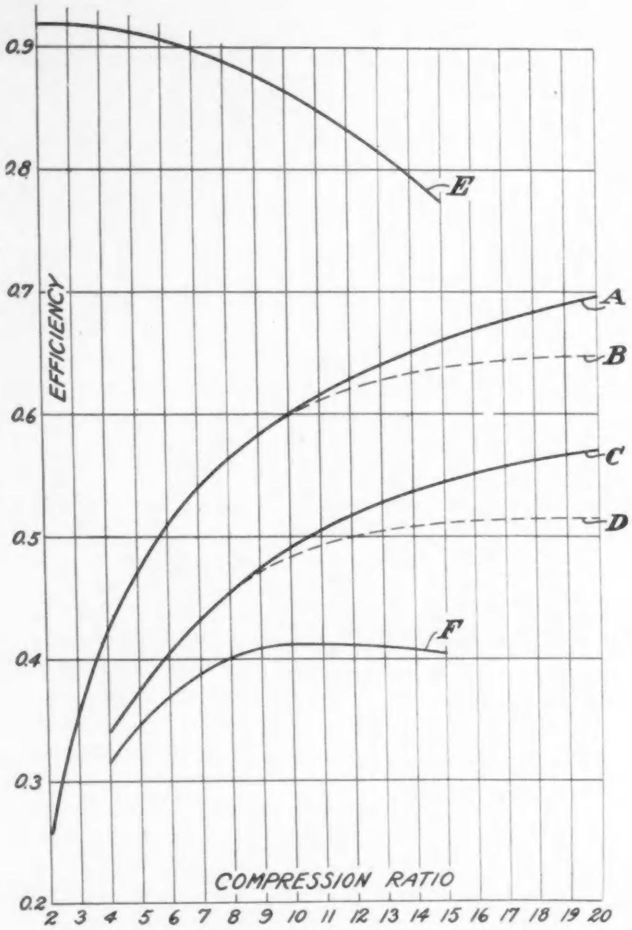


Fig. 5—Curves Showing Values of the Air-Standard Efficiency for Different Compression Ratios

compression oil-engine, but the figures available show that the friction increases rapidly with the compression ratio.

Güldner gives the values shown by Curve *E* of Fig. 5, and Biggar, of Leyland Motors, Ltd., mentions the figure 79 per cent for a compression-ignition engine with a 16:1 compression ratio and 87 per cent for gasoline engines with a 5.5:1 ratio.

Although the figures for the mechanical efficiency of engines of different designs vary within rather wide limits, the curve given by Güldner no doubt gives a true picture of the character of the variation in the mechanical efficiency with different compression ratios. If the values given by Güldner are multiplied by those calculated by Pye for an actual working medium and a maximum pressure of 915 lb. per sq. in., the efficiency shown by Curve *F* of Fig. 5 is obtained. According to this curve, the most efficient engine should be an engine working with a compression ratio of about 10:1. As a matter of fact, very little is gained by going over a ratio of 9:1. In this connection, it should be remembered that we are dealing with high-speed engines. The peculiar thing is that, with a few rare exceptions such as special high-compression airplane-engines and the like, there is no commercial engine working with this optimum compression ratio. All carburetor engines are well below this desired compression ratio, and all high-speed compression-ignition engines are considerably above it. The question then arises as to the reason for this situation. It is the fuel that gives the answer to this question. The properties of the fuel determine the compression ratio in compression-ignition engines as well as in gasoline engines.

In a compression-ignition engine it is necessary for well-known reasons to obtain ignition of the injected fuel almost immediately after injection. To obtain this rapid ignition, the fuel must reach its ignition temperature in a period of time corresponding to only a few degrees of crankshaft travel. The fuel therefore must be injected into an atmosphere the temperature of which is well over the ignition temperature of the fuel, and this temperature is obtained by a high compression-ratio. In a carburetor engine, on the other hand, all of the fuel is introduced into the cylinder during the suction stroke. To avoid spontaneous and uncontrolled ignition of the charge, it is necessary to keep the temperatures and consequently the compression ratio relatively low. In the carburetor engine the heating of the fuel is objectionable, and in the compression-ignition engine it is desirable. It is obvious that the heating of the fuel is a question of temperature, but it must not be overlooked that it is also a question of time. In a carburetor engine the fuel picks up heat from the walls of the combustion chamber during the 360 deg. of the suction and compression strokes, and is exposed to the heat of compression during the whole compression stroke.

Is it not possible to use a higher compression-ratio in a spark-ignition engine if the time during which the fuel is exposed to heat is decreased? It is. This is, however, possible only in an injection-type engine, and it is one of the principles of the Hesselman engine. In this engine, fuel injection starts 50 to 60 deg. before top dead-center, and the fuel is subjected to the heat of the combustion chamber dur-

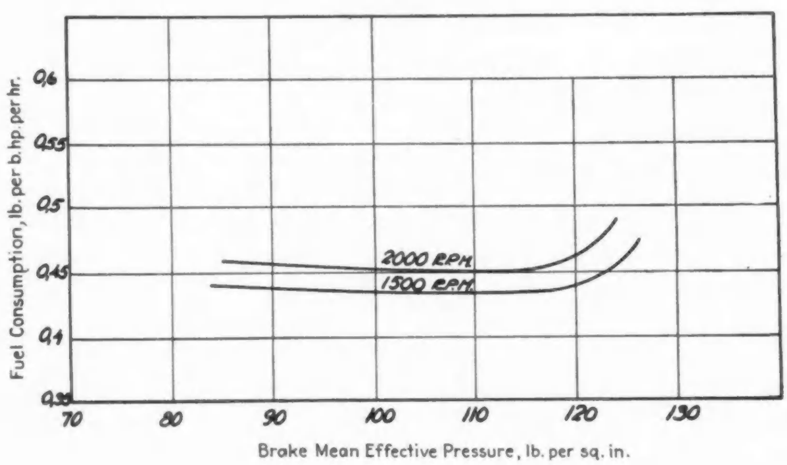


Fig. 6—Fuel-Consumption Curves Obtained from Tests of a Hesselman Engine

ing a relatively short time. Depending upon the fuel used, and the size and design of the engine, Hesselman engines can work with compression ratios of from 6:1 to 10:1.

The factor that limits the output of an engine of a given size is the air. It is possible to supply an almost unlimited amount of fuel to the engine, but the air supply is limited by the swept volume. It is therefore necessary to make the best possible use of the air. In a carburetor engine this is rather easy. Fuel is supplied to the cylinder during the suction stroke and has plenty of time in which to mix with the air and evaporate, and at the end of the compression stroke a homogeneous gas-mixture is ready to be ignited. When the spark ignites this mixture, one of the most efficient processes of combustion and flame propagation known to engineers is started.

In the compression-ignition engine the mixing of the fuel with the air is a comparatively difficult problem, and much of the development work on this type of engine has been concentrated on this point. It is necessary for the injected fuel to be evenly distributed throughout the air-charge of the combustion chamber and, to obtain this distribution, the combustion chamber has been formed so as to suit the shape of the spray, the air-charge has been given a rotating or turbulent movement, or pre-combustion chambers have been employed. It is a well-known fact, however, that the compression-ignition engine does not utilize the air very efficiently, and it is necessary to supply a considerable amount of excess air to this type of engine. The reason for this is obvious.

There are two factors controlling the mixing of the fuel with the air. One is space and the other is time. The first factor is usually well taken care of. The other factor, however, cannot be taken care of as easily in a compression-ignition engine because it is necessary, for the proper operation of the engine, that the fuel be burned as soon as possible after it comes into contact with the air in the combustion chamber. Only the first fuel injected meets fresh air. The fuel thereafter injected has to be injected through air that has already been utilized. This necessarily brings about the condition that in some parts of the combustion chamber more fuel is concentrated than can be burned without smoke; whereas, in other parts, there is a surplus of air not reached by the fuel and thus not utilized.

In the Hesselman engine where the fuel-injection starts 50 to 60 deg. before top dead-center, the fuel has a certain time after it is injected to mix thoroughly with the air and, when ignition occurs, the spark ignites a pre-formed mixture and the combustion process is the same as in a carburetor engine. It is in this way possible to make very good use of the air, and high power can be obtained with a clean exhaust. With a properly designed nozzle, the exhaust remains invisible up to very near the maximum obtainable power.

To sum up, the fuel injection in the Hesselman engine is timed so late that the fuel is not unduly heated, but early enough so that a complete mixture is formed before ignition. This engine thus fulfils the two main requirements for an internal-combustion engine. It works on an efficient cycle and it utilizes air efficiently.

Fig. 6 shows two fuel-consumption curves obtained from tests of a 7.5:1 compression-ratio Hesselman oil-engine having a 4.13-in. bore and a 5.35-in. stroke. These results must be considered as good for a high-speed oil-engine, but should by no means be regarded as final for this engine type.

Although much research work has been done on this engine, it is only a fraction of what has been done on carburetor and compression-ignition engines, and there are still possibilities for improving both the fuel consumption and the power output of engines of this type.

The results shown in Fig. 6 were obtained with an engine having a combustion chamber of the design shown in Fig. 7. This combustion chamber differs from the design originally used, as shown in Fig. 1. In the design now used, the spark plug and the injection nozzle are placed in the cylinder head instead of in the block. This has the advantage that it is no longer necessary to split the collar on the piston for the spark plug and the injection nozzle. Consequently, the piston rings can be carried in the collar of the piston and the piston itself can be made shorter and lighter. Due to the better heat conduction through the piston rings, the temperature of the collar is lowered and a higher compression-ratio can be used because of the resulting cooler combustion-chamber.

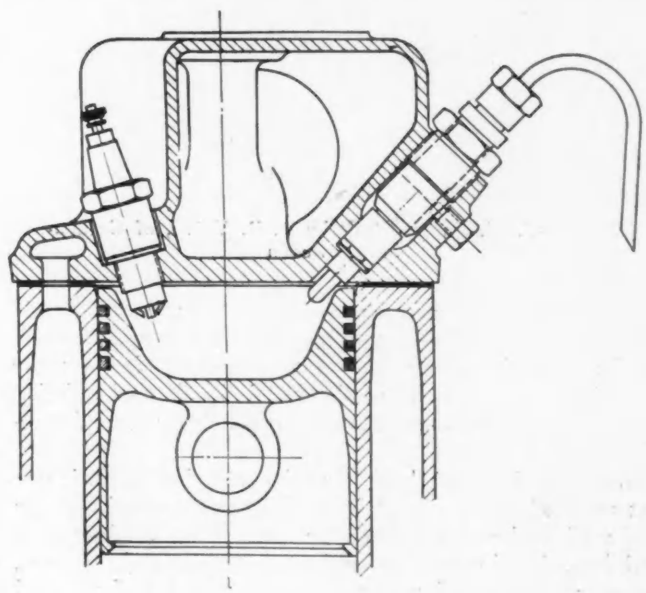


Fig. 7—Combustion Chamber Differing from the Original Design

This combustion chamber has an extremely compact and simple shape. With regard to heat losses, it has a decided advantage over most of the modern high-speed compression-ignition engines, where the gases are forced through narrow passages with resulting appreciable heat and pumping losses. This combustion chamber lends itself very well to a thorough mixing of the fuel with the air, as it has no dead pockets, throats or clearances where the fuel cannot reach the air. The importance of this is illustrated by the following example.

For certain reasons, a Hesselman engine was built with a clearance outside of the piston collar containing roughly 10 per cent of the volume of the combustion chamber. This engine did not give satisfactory power, and the reason was simple. The 10 per cent of the air in the dead pocket outside the collar was never reached by the fuel. By changing the design so that the pocket was eliminated, the output of the engine was increased in proportion to the additional amount of air reached by the fuel.

No matter how good an engine may be with respect to fuel

Fig. 8—Truck Engine Built by A. B. Volvo, of Gothenburg, Sweden

consumption, power and general performance, its commercial value is very much restricted if it is sensitive to differences in the properties of the fuel. For the engine designer, the most important property of the fuel is its thermal stability. In gasoline engines, fuels of low thermal stability cause detonation and knocking.

When the high-speed Diesel-engine was developed, it was not expected that it would be sensitive to the quality of the fuel used, and no troubles of the same nature as detonation and knocking in gasoline engines were expected. It was, however, soon found that the thermal stability of the fuel was of the same importance as in the gasoline engine. In the compression-ignition engine, however, fuels with low thermal stability are the best, and fuels which have a high thermal-stability might cause very bad knocking and rapid pressure-rise in engines having smooth operation on suitable fuels. If the thermal stability is very high, the ignition lag might be so long that the ignition occurs after most of the fuel is injected,

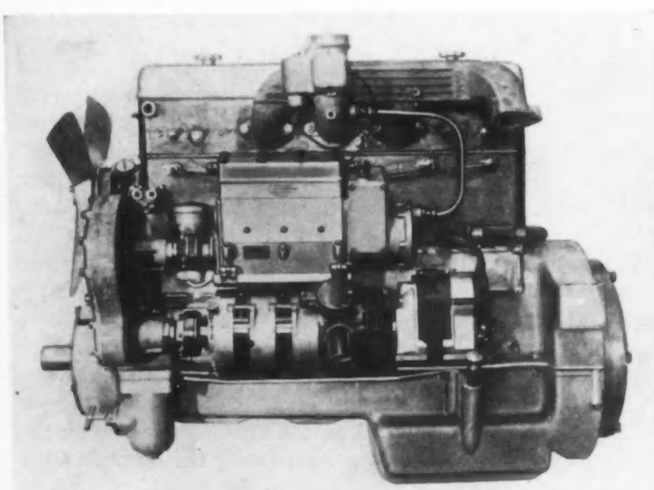


Fig. 9—Truck Engine Built by the Swedish Firm of Scania Vabis

which, in a high-compression engine, gives tremendous maximum pressures.

During the last few years, synthetic or cracked fuels have appeared on the market. These are produced by high-pressure cracking-processes. Such fuels contain a much higher percentage of aromatics than the fuels distilled from crudes. They have, therefore, a high thermal-stability, and are not very well suited for high-speed compression-ignition engines. Benzol, alcohol and most of the vegetable oils also are impossible as Diesel fuels on account of their thermal stability.

In a spark-ignition engine the local high temperature of the electric spark is, however, sufficient to start the ignition even of a fuel with the highest thermal-stability, and from the spark the flame front advances through the mixture, which burns in an orderly manner. As these fuels are not liable to self-ignition, and to knocking, a very high compression-ratio can be used if desired, and these fuels, some of which are very cheap because they cannot be used as Diesel fuels, are for the Hesselman engine what the premium gasolines are for the carburetor engine.

Very interesting tests have been made with tar oil obtained as a by-product from coke manufacture. It has hitherto been difficult to find a use for this oil, which in some countries is produced in abundance. It has a very high thermal-stability and is an excellent fuel for the spark-ignition injection-engine. Engines of this type have also been operated with good results with alcohol, and there is nothing to prevent the use of gasoline.

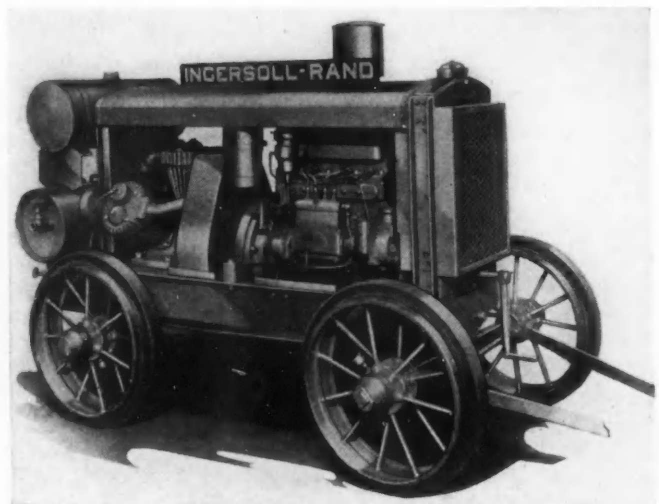


Fig. 10—An American-Built Four-Cylinder Engine Used for a Portable Air-Compressor

The carburetor engine needs a fuel that can be easily vaporized, and the compression-ignition engine needs a fuel of low thermal-stability. For the Hesselman spark-ignition injection-engine neither of these properties is necessary, and with regard to fuel this engine is the real universal engine, since almost any fluid fuel can be used, provided the viscosity is not too high. This is a very important factor, because, in addition to being very economical, the engine offers the additional advantage of the possibility of using the fuel which at the moment is the cheapest in the locality where the engine is used.

On account of the great variety of fuels that can be used, the problem of distribution is simplified. This is a question of less importance in some countries than in others. If we

take, for example, a country such as England, which has a relatively small area, and where practically all the fuels are imported, it is relatively easy to specify and to distribute a fuel that is particularly suitable for high-speed compression-ignition engines. On the other hand, in a country of large area, and one where oil of different qualities is produced in different parts of the country, it is much more advantageous to be rid of the dependence on a certain quality of fuel. This is also very important for export business.

Twenty-five different models of Hesselman spark-ignition oil-engines are now being built, and the engines are being used for trucks, tractors, buses, motorboats, and for stationary purposes. Experimental work is being carried out on aircraft engines.

Fig. 8 shows a six-cylinder $3\frac{1}{2}$ x 4.3-in. truck-engine built by A. B. Volvo of Gothenburg, Sweden, and Fig. 9 shows a 4.13 x 5.35-in. bus and truck engine built by the Swedish firm of Scania Vabis. About 500 of these engines are now in use in different parts of the world, including China, the Dutch East Indies, Africa and South America.

Fig. 10 shows an American-built four-cylinder engine used for a portable air-compressor. Over 500 of these engines have been sold in different countries in Europe, and all over Europe American-built spark-ignition oil-engines are now competing most successfully with European compression-ignition engines.

From a practical standpoint, one of the important advantages is ease of starting. It is not practical to carry batteries for starters and glow plugs on many types of industrial engines and tractors, and with an oil engine it is no doubt a decided advantage to retain the certainty and ease of hand starting of the gasoline engine. It is well worth while to know that even engines up to $6\frac{1}{2}$-in. bore and 8-in. stroke are started by hand.

The engine shown in Fig. 11 has been used during the past year by the Swedish Customs for Coast Guard boats. These boats operate winter and summer on the coast and in the open waters of the Baltic Sea not far from the Arctic Circle. Ease of starting and reliability of operation under all circumstances are therefore very important factors in this case. After thorough tests with this relatively small engine, the authorities have decided to equip their larger boats with spark-ignition oil-engines, and a special $6\frac{1}{2}$ x 8-in. type of engine with six cylinders is now being built for this purpose. Beside the good economy and ease of starting, the freedom from fire hazard was one of the deciding factors in this instance.

Several engine types are built for railcar use, and Fig. 12

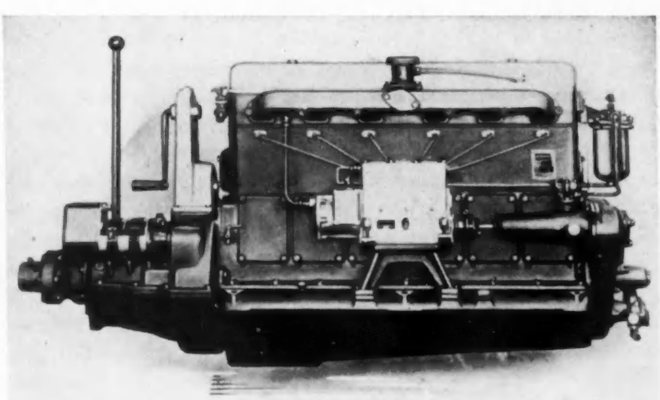


Fig. 11—Engine Used by the Swedish Customs for Coast-Guard Boats

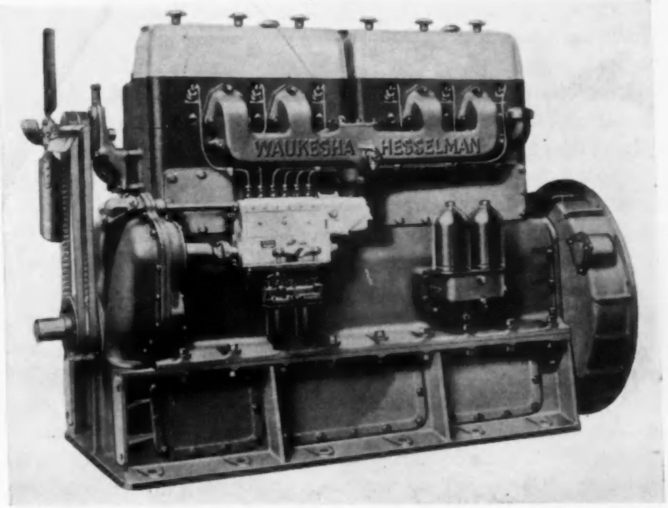


Fig. 12—Engine Built by the Waukesha Motor Co. for Railcar Use

shows a $6\frac{1}{2}$ x 7-in. six-cylinder engine suitable for this purpose, built by the Waukesha Motor Co.

In conclusion I wish to say that, although the high-power spark-ignition oil-engine is a comparatively recent development, satisfactory results have been obtained, and it has been proved that the basic principles are sound. The engine has proved its practicability and reliability in several fields. It is expected that the immediate future will witness further very interesting developments of this type of engine, and several well-known firms in the United States, England, Germany, Italy, Sweden and Austria are now cooperating on the further development of the Hesselman spark-ignition injection-engine.

Discussion

Two Opposite Lines of Development Suggested

—F. C. Mock
Bendix Research Corp.

IN our research work, which is largely concerned with fuel feeds, this engine, the carburetor engine, and the compression-ignition engine, all seem brothers in the same family. With each the fuel must be metered, then vaporized or "cracked" to the molecular state, then diffused in the air charge, and then ignited, in order that efficient combustion may be realized. From our experience with them all, I am rather certain that several forms of the fuel-injection spark-ignition type will be found advantageous for different automotive duties.

An outstanding characteristic of this type of engine—as with the Diesel—is the tendency toward "stratification" of the fuel. To anyone contemplating experimental work along this line, I would recommend starting with a single cylinder, with as many tapped holes for spark plugs as can be conveniently arranged; as it probably will be found, when this test engine is first started, that considerably leaner fuel-charges can be ignited with some plug locations than with others.

Further work probably will disclose that this engine may

be developed in two opposite directions. One extreme will have turbulence, injection of fuel on the intake stroke to give a longer time for vaporization, and fairly complete mixing of the charge. It will have more power than the carburetor engine of the same displacement, fire with leaner mixtures and behave better in every way; but it will have nearly the same detonation limitations on fuel as the carburetor engine would have if supercharged to the same power, with equally low intake-charge temperature. While it will have high maximum explosive pressures, it will not have the tendency to "thump" sometimes found with the compression-ignition engine. Its fuel and air charges will have to be accurately coordinated, just as with the carburetor engine. Its fuel consumption, in pounds of fuel, times British thermal units per pound, per horsepower hour, will be a little better than with a carburetor engine well designed for low fuel-consumption—which many are not—but not as low as with the compression-ignition engine working under favorable conditions.

The other extreme of development of this engine will have a much higher compression ratio than could be tolerated with a full homogeneous charge of air and fuel, detonation being prevented by limiting the turbulence and by injecting a reduced fuel-charge just before ignition in such a way that it is localized to something better than a 16:1 air-fuel ratio around the spark plug, with a leaner ratio existing in the farther positions of the combustion chamber. Such an engine will have lower mean effective pressure than the above-mentioned form or the carburetor engine; its specific fuel-consumption will tend to be lower by virtue of the higher compression and expansion ratio, but higher because the air dilution will reduce the efficiency of the cycle; also, higher because there may be stray wisps of fuel vapor in the extreme portions of the combustion chamber, separated from the main fuel-charge by zones of air alone, by which complete ignition may be delayed. I want to say that, for any given compression ratio, we have always gotten lower fuel-consumption with what seemed to be a homogeneous air-fuel mixture than with any stratified condition which may be offset if the latter permits a higher compression-ratio. With this combination, close coordination of the fuel-air ratio may not be so necessary.

Actually, a compromise between these two extremes would be chosen. I must confess that in our own efforts to approach the second form, with an open combustion-chamber, we have usually gotten a rather cantankerous engine, one acting something like these hard-starting small two-cycle marine-engines; however, I hope that other experimenters may be more successful. I would say also that our experience definitely approves the detail design of the newer form shown in Fig. 7 of Mr. Dillstrom's paper.

Results of Tests Made at Langley Field Outlined

—A. M. Rothrock
Associate Physicist,
National Advisory Committee for Aeronautics

THE use of spark-ignition with the injection of heavy fuels undoubtedly offers interesting possibility and Mr. Hesselman and his co-workers have obtained some very interesting results with this combination. Fig. 5 of Mr. Dillstrom's paper, showing the efficiency of the various compression ratios, is interesting. I think it is about time that we discard the air-cycle efficiency entirely, because the more correct data such as that given by Mr. Pye is so much more useful. I do not believe that curve *E*, and, as a result, curve *F*, is representative, particularly in the light of the fuel consumptions given in Fig. 6 for the Hesselman engine. The minimum consumption is about 0.43 lb. per b.hp.-hr., while a consumption of 0.40 is fairly common with the compression-ignition engine and the Junkers aeronautical engine shows a consumption of 0.36. So, for the present, the compression-ignition engine still has the advantage on fuel consumption.

We conducted some tests at Langley Field two years ago on spark ignition with fuel injection. Using the N.A.C.A. combustion apparatus at a compression ratio of 13 we injected Diesel fuel, gasoline, and hydrogenated safety fuel. Although the air pressure was comparable to that experienced in the conventional engine the air temperature was much lower, so much so that Diesel fuel would not auto-ignite unless the engine jacket was heated to 250 deg. fahr. The most interesting results found from these tests was that the most complete combustion with injection on the compression stroke occurred with the injection of the fuel leading the igniting spark by about 30 crankshaft deg. at a speed of 1500 r.p.m. This relationship held whether the fuel was injected at 50 deg. before top-center or 80 deg. before top-center. With a time interval of less than 30 crankshaft deg. between injection and spark, the combustion became slightly weaker until the point was reached at which no ignition took place. With a time interval greater than 30 deg., the combustion got progressively weaker until the injection was leading the igniting spark by 180 crankshaft deg. or more. Then the combustion again became stronger, finally showing the typical spark-ignition detonation. From the data given in Mr. Dillstrom's paper, the lead of the injection over the spark was about the same as that which we found to give the maximum combustion.

It is true that the mixing of the fuel and air in a compression-ignition engine is a difficult problem. The rate of mixing depends on the rate of fuel-spray disintegration, vaporization, and diffusion, as well as on the time and space. If the fuel is injected into the engine on the intake stroke, all of these events occur comparatively slowly. As the time of injection is changed to take place on the compression stroke, the rates increase but the time available for the mixing decreases. The increase in the rates is caused by the increase in the density and temperature of the air into which the fuel is sprayed.

It is only on the last part of the compression stroke, however, that the increase becomes appreciable. At a compression ratio of 13 the air density at 50 deg. before top-center is 3.5 times that during the intake stroke; whereas, at 20 deg. before top-center, the density has increased to 8.5 times its original value. We therefore see that the condition of the air into which the fuel is sprayed must also be considered in comparing different methods of obtaining combustible mixtures in the engine. Although it is true that the compression-ignition engine does not utilize all the air available, neither does the engine described by Mr. Dillstrom; for, otherwise, the brake mean effective pressure would be appreciably higher than that given in Fig. 6. It would be interesting to know at what compression ratio the data were obtained. For complete utilization of the air at a compression ratio of 6—the minimum mentioned by Mr. Dillstrom—the brake mean effective pressure should be in the neighborhood of 135 lb. per sq. in.

Automotive Engineering Balancing Problems

By Thomas C. Van Degrift and John M. Tyler
General Motors Research Laboratories

THE authors state that the balance of a machine part or group of machine parts is a function of the motion of their center of gravity, and that perfect balance of the moving parts exists when their center of gravity remains stationary.

When the center of gravity oscillates, unbalance is present, the amount being proportional to the magnitude of the oscillation of the center of gravity.

The subject of balancing is discussed practically, balancing machines being also described and commented upon. The seven main requirements of a good balancing machine are stated.

Regarding balance limits, in computing those for an assembled engine, the first item is to obtain the balance on each of the rotating parts and the second, to ascertain the limit to be placed on the fits of "pilots." In conclusion, fourteen items constituting the total unbalance of the engine chosen for illustration are enumerated.

THE balancing of rotating parts is one of the oldest problems and probably the one with more mystery attached to it than to any other problem in mechanical engineering. Years ago, noise and vibration in machinery used by the public was not considered to be objectionable. In fact, rotating machinery was expected to be noisy and rough in its performance. The power of an engine was often judged by the noise it made. You probably have all heard of "power roar," "the good old hum" and expressions of a like nature. These expressions have all passed on, and we are now grading engines and cars according to their smoothness. The automobile buying public does not want to hear or feel vibrations produced by the powerplant of the car. This problem is not as mysterious as it may seem on first sight, and the purpose of this paper is to try to make this subject a little clearer for those who do not come into contact with balancing problems every day.

The balance of a machine part or group of machine parts is a function of the motion of the center of gravity of that part or group of parts. Perfect balance of the moving parts exists when their center of gravity remains stationary. When the center of gravity oscillates, unbalance is present, the amount being proportional to the magnitude of the oscillation of the center of gravity.

If a rotating body is supported on a fixed axis with its center of gravity on this axis, the center of gravity will remain stationary as the body rotates. This body is then in balance. If the center of gravity of the body is a distance e from the axis of rotation, it is unbalanced by an amount we, where w is the weight of the body. This type of unbalance is called rotational unbalance.

The center of gravity of a reciprocating part of a machine moves with the reciprocating part and produces an unbalance equal to the product of the weight of the part and its amplitude of motion. This type of unbalance is called reciprocating unbalance.

If one could hold an engine in his hands and let it run and not feel any vibration, the engine would be in balance. Individual parts might be very badly unbalanced, but the sum of all of these unbalances would add up to zero. The instantaneous center of gravity of the whole engine mechanism would remain stationary in space.

Another way of looking at this phenomenon of unbalance is that the acceleration of a machine part involves a force which reacts on the machine, tending to move it in the opposite direction. An unbalanced rotating body involves a constant angular acceleration of the center of gravity of the body which produces a rotating force. This force passes through the axis of rotation and acts in the direction of the center of gravity of the body. This force is called centrifugal force and, at a given speed, is in proportion to the product of the weight of the body and the distance of its center of gravity from the axis of rotation. A reciprocating body involves a variable linear acceleration. The force reacting on the machine tends to push the machine forward and backward in line with the motion of the reciprocating body. The amplitude of this variable force at a given frequency of motion is in proportion to the product of the weight of the body and its amplitude of motion.

[This paper was presented at the Production Meeting of the Society, Detroit, Oct. 10, 1934.]

If several machine parts are bolted together into one assembly as shown in Fig. 1, and each part is unbalanced with respect to the axis of rotation, the unbalance of the assembly is the vectorial sum of the individual unbalances. This resultant unbalance can be eliminated by the addition of another equal unbalance placed at 180 deg. from it so as to oppose or "balance out" the unbalance of the assembly. This process can be considered as either a balancing of centrifugal forces until the bearing loads are zero, or as a juggling of centers of gravity, until the center of gravity of the assembly is on the axis of rotation.

If we have a reciprocating unbalance, say the reciprocating parts of a single-cylinder engine as shown in full lines in Fig. 2, unbalanced forces will be set up which can be balanced only by setting up a duplicate set of counter forces. The addition of a duplicate reciprocating system connected to the crankshaft on the opposite side, shown in dotted line in Fig. 2, will accomplish this result, although the addition of another cylinder in line with the first, as in Fig. 3, will not. The angularity of the connecting rod introduces irregularities in the piston motions so that, with the arrangement shown in Fig. 3, the reciprocating forces do not balance out completely.

The two types of unbalance in automotive engines, inherent reciprocating unbalance and rotational unbalance, must be handled by two different groups of engineers, the designers and the balancing department. The design of the engine determines its inherent unbalance, that is, the balance of reciprocating parts. The one, two, three and four-cylinder engines of the conventional type are inherently unbalanced because the forces of the reciprocating parts do not balance each other. Several designs of eight-cylinder engines are also unbalanced such as: the straight eight with a crankshaft which has four throws in one plane at one end and four throws in a plane at 90 deg. at the other, the 90 deg. V-eight with all throws in one plane, and the 60 deg. V-eight. No matter how accurately the individual parts of these engines are balanced, the engine as a whole is unbalanced. At present, however, there are practically no passenger cars built in America with inherently unbalanced engines. The four was the last to disappear. Now, the only unbalance is the rotational unbalance.

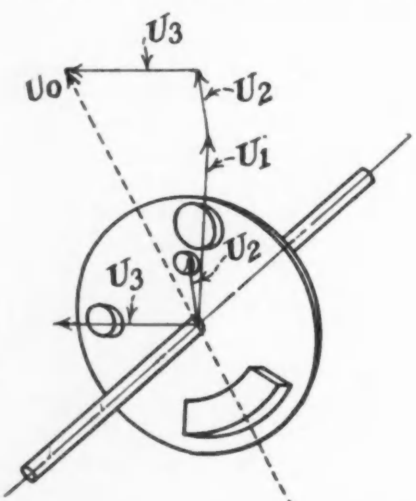


Fig. 1—Several Machine Parts Bolted Together into One Unbalanced Assembly

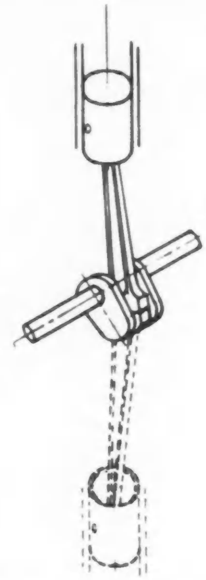


Fig. 2—Illustration of Reciprocating Unbalance

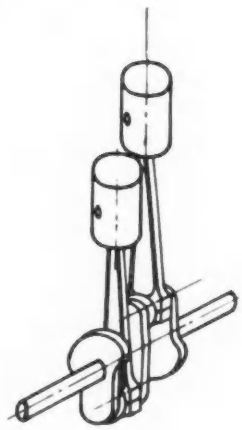


Fig. 3—An Arrangement in Which the Reciprocating Forces Do Not Balance Out Completely

Thus far, the discussion of rotational balance has been confined to thin bodies, such as the one shown in Fig. 1, rotating about an axis perpendicular to the plane of the body. If the body has considerable length along the axis of rotation, we must work with a gravity axis instead of a center of gravity.

Consider for the moment a long irregular body such as a crankshaft. If the shaft is cut by closely spaced planes at right angles to its main bearing centerline and the center of gravity of each section is plotted in a polar diagram, it will be found that the curve connecting these centers of gravity points is an irregular spiral. It is obviously impossible to balance each of these sections individually but, if they are all properly spaced so that the shaft will rotate without any centrifugal bearing loads at either end, the shaft will be in balance. The balance of the shaft can be calculated by taking moments of the unbalance of each section about one end main bearing and thus computing the reaction at the other main bearing. Then, an additional weight at this other end can be added to reduce the bearing reaction to zero. The process may then be reversed and the weight found which may be added at the other end to reduce its bearing reaction to zero. The shaft is then balanced about its axis of rotation; the gravity axis has been made to coincide with the axis of rotation.

Engineers often split up the unbalance of a body which has considerable length along the axis of rotation into "static" and "dynamic" unbalance. Static unbalance is so called because it can be detected by a static test. A crankshaft, for example, can be placed with its end main bearings on level straight rails and the heavy side of the crankshaft will cause the shaft to roll until the heavy side reaches the bottom. By experimentally changing the balance of the shaft until it has no tendency to roll from any position, the shaft will be brought into static balance.

Dynamic balance is so called because it can be detected

by a running test only. Dynamic unbalance produces a couple which tends to rock the body about its center of gravity with a rotary motion. The only means available for detecting the dynamic unbalance of a body is the measurement of the movement of the body when rotated in flexible bearings.

Using the same example as before, if one could hold an engine in his hands, say with one hand at the front and the other at the rear, and let it run and not feel any vibratory movement of the crankshaft axis, the engine would be in dynamic balance.

Balancing Machines

The balancing machinery in use in the automotive industry for balance of rotating parts includes a wide range of designs. Static unbalance is measured on machines which rotate the part to be balanced and also on machines which allow the part to find a stationary position, which is determined by its balance. Dynamic unbalance is always measured by rotating the part to be balanced, but some machines require that it be rotated at or near the resonant frequency of its mounting and other machines use a speed above or below resonance.

Of the two types of static balancing machines already mentioned, there is considerable difference in the accuracy. In a machine where the unbalanced part is not rotated, the actuating force available to overcome the friction of the suspension, and move the part to a position which indicates its unbalance, is the couple of the unbalance itself. In a machine where the unbalanced part is rotated, the actuating force available to overcome the friction of the suspension and move the part to a position which indicates its unbalance is the centrifugal force of the unbalance. This centrifugal force may be adjusted to any desired value by regulation of the operating speed. For a given refinement of indicating mechanism and suspension, the rotating balancing machines have an accuracy of 5, 10 or 100 times that of the stationary machines, depending on the speed of rotation. Another distinct advantage of the rotating machine is that its motion helps it to settle at its exact position of equilibrium.

The widest divergence in the design of balancing machines is found in the means used for indicating the unbalance. Of the methods used in connection with rotating machines, there are three in general use. One method involves the addition of a known unbalance at two different angles; first one, then another. The readings of the motion of the part to be balanced are then used in a slide-rule arrangement to compute the angle and amount of the unbalance in the part being balanced. A second method is to add unbalance experimentally to the part being balanced until the movement of the part is zero. The angle and amount of unbalance added to the shaft can then be read from the machine.

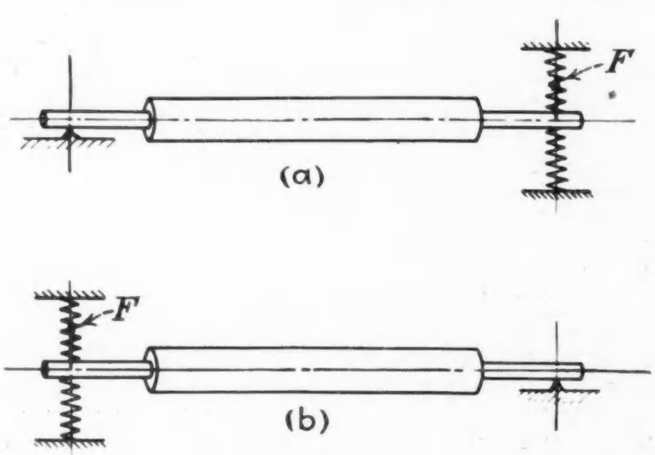


Fig. 4—Principles Involved in the Moment Balance
The letter *F* indicates the bearing reaction due to unbalance at one end of the shaft

A third type of indicating mechanism has been developed by the Research Division of the General Motors Corp., and is direct reading for both angle and amount of unbalance.

The foregoing indicating mechanisms are used on rotating balancing machines to read both static and dynamic unbalance. There is some divergence, however, in the methods employed to obtain dynamic balance. One method is to read the static unbalance first, correct for it, and then read the dynamic unbalance. The other more common method is to pivot the shaft at one end and read the motion at the other end; then to reverse the process and pivot the shaft at the end which was free to oscillate and allow the end which was pivoted for the first reading to oscillate for the second reading. These two readings give the angle and amount of a correction for each end of the shaft. This method has three distinct advantages over the first. The complete indication of shaft unbalance is made without removing the shaft from the machine, the shaft is balanced by making two corrections instead of three, and the limits of unbalance are not added to each other in the second method as they are in the first. The balancing machines using the second method for indicating the unbalance make use of the principles involved in the moment balance illustrated in Fig. 4. The movement of the free end is an indication of the unbalanced force at that end.

If the amplitude of motion of the free end of the body being balanced is plotted against speed of rotation, a response curve as shown in Fig. 5 will be obtained. The sharpness of the resonance peak will depend on the amount of friction in the system. The oscillation at or near resonance is rather erratic; slight changes in speed and slight changes in friction produce large changes in the reading of unbalance of the body being balanced. These changes apply to location as well as amount of unbalance. However, some machines are built using this speed range because the amplitudes are much larger than in any other speed range. In the General Motors Research Corp. balancing machines the operating speed is on the flat part of the curve, above resonance, where the indication of unbalance is independent of both speed variation and friction variation. The amplitude of motion is magnified in an optical indicator.

The requirements of a good balancing machine are that:

(1) It must be sensitive enough to indicate the unbalance with an accuracy of plus or minus less than one-fourth of the balancing limits.

(2) The reading of both amount and location of the unbalance should be immediately indicated when the machine is started so that a high production can be obtained.

(3) The unbalance should be indicated without the necessity for an adjustment of the machine for each part being balanced.

(4) The part being balanced should not be distorted due to high speed whip.

(5) The operation of the machine and the reading of the unbalance should be simple enough to allow an inexperienced man to learn to use the machine in a few minutes.

(6) The complete reading of unbalance should be taken without removing the part from the machine.

(7) The handling of the shaft in putting it into the machine and taking it out should be simple and easy, and it should be possible to check the balance of the part in the same machine used to read the unbalance.

There are many other important items to be checked over, but the foregoing are the main requirements.

Turning to some simple mathematics of balancing, we find that a physical interpretation of the curves shown in Fig. 5 throws considerable light on the principles involved in balancing machines. Consider first a body in a static balancing-machine. The equation of the outside curve in Fig. 5 is

$$X = \frac{we}{W} \cdot \frac{m^2}{p^2 - m^2} \tag{1}$$

where X is the amplitude of motion, we the unbalance, W the weight of the body being balanced, m the speed of rotation and p the speed at which resonance occurs. The term representing damping has been omitted from the equation and therefore the amplitude at $p = m$ is indeterminate. Actually, this amplitude will be limited to a finite value but, at and near this speed, the amplitude will be erratic. As the speed increases above resonance, the amplitude approaches the value

$$X = \frac{we}{W} \text{ or } \frac{Unbalance}{Weight\ of\ Piece} \tag{2}$$

where p^2 is negligible compared to m^2. This represents the condition where the center of gravity is stationary.

The motion of a dynamically unbalanced rotating body may be represented by equations similar to those above if each linear quantity in equation (2) is replaced by the corresponding quantity involved in rotational motion. Thus the dynamic unbalance is wel, where we is unbalance as before and l is the length between the unbalances as shown in Fig. 6. If X is the amplitude at the end, the angular oscillation of the axis of the body is $X/0.5$, which will be represented by Q. The mass factor involved in this system is I, the moment of inertia of the body about an axis perpendicular to the axis of rotation through the center of gravity. The response of the body to dynamic unbalance is then

$$Q = \frac{wel}{I} \cdot \frac{m^2}{p^2 - m^2} \tag{3}$$

Applying the foregoing information to balancing procedure, we find that the balancing machine if properly designed measures, for static unbalance, the distance and direction of the center of gravity of the body from the axis of rotation; and, for dynamic unbalance, the distance and direction of the gravity axis from the axis of rotation at each end.

Balance Limits

The unbalance of the assembled engine is the accumulation of the unbalance from a dozen different sources. Every rotating or reciprocating part in the engine must be checked for balance and weight. Even small parts which are machined all over will vary considerably, due to porosity of castings or the eccentricities produced in machining within limits. The first item, then, in computing the balance limits on the assembled engine, is the balance limits on each of the rotating parts. The second item is the limit placed on fits of pilots. Even though a part is in balance it may be piloted eccentric to the axis of rotation and an additional

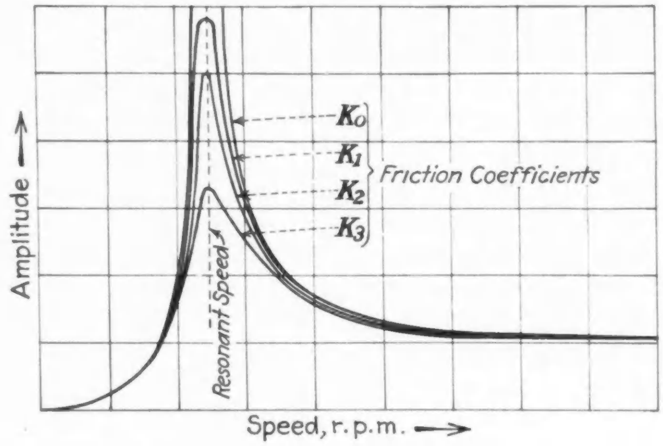


Fig. 5—Response Curves for Different Coefficients of Friction

unbalance is introduced which is equal to the product of the weight of the part and the eccentricity of the pilot. Crankpins can be considered as pilots in this analysis. Each crankpin locates the connecting rod and total reciprocating mass, both as to angle and radius. Thus, if the reciprocating masses are all exactly equal in weight, but one crankpin is at a greater radius than the other by an amount E, a rotational unbalance will be introduced equal to the product of the weight of the lower end of the connecting rod and the value E. A reciprocating unbalance is also introduced, its value being equal to the product of the weight of the reciprocating parts and E. Of course, the variation in weights of the connecting rods and reciprocating and piston assemblies is an additional unbalance added to the assembly.

Another chance for unbalance to creep into the assembly is in sliding fits, such as the pilot for the clutch pressure-plate and fittings on spline shafts. These guiding surfaces often require considerable clearances and, for that reason, considerable unbalance is often introduced at these points.

Summing up the total unbalance of the engine with the following balance limits, we have:

(1) Unbalance in the crankshaft may be 0.75 oz.-in.

(2) Unbalance in the flywheel (½ oz.-in.) plus the product of the weight of the flywheel (75 lb.) and the eccentricity of its pilot (0.001 in), giving a total of 1.7 oz.-in.

(3) Unbalance of the clutch cover (½ oz.-in.) plus the product of the weight of the clutch cover (20 lb.) and the sum of the eccentricity of the clutch pilot (0.004 in.) and the flywheel pilot (0.001 in.), giving a total of 2.1 oz.-in.

(4) Unbalance of the clutch pressure-plate (½ oz.-in.) and the unbalance introduced by clearance around the clutch pressure-plate which is the product of the weight of the clutch pressure-plate (10 lb.) and the sum of its clearance (0.005 in.), the clutch pilot (0.004 in.) and the flywheel pilot (0.001 in.) giving a total of 2.1 oz.-in.

(5) Unbalance of the clutch disc (¼ oz.-in.) plus the product of the weight of the clutch disc (2 lb.) and the clearance of the spline pilot (0.003 in.) giving a total of 0.35 oz.-in.

(6) Unbalance due to the variation of the weight of the lower end of the connecting rods (1/16 oz.) assuming a stroke of 3 in., plus the product of the weight of the lower end of the connecting rods (1 lb.) and the variation in radius of the crankpins (0.010 in.), giving a total of 0.34 oz.-in.

(7) Unbalance introduced by variation of angular position

of the crankpins ($\pm$0.005 in.) gives 0.08 oz.-in. for the shift of the lower end of each connecting rod.

(8) Unbalance introduced by variation in weight of the reciprocating parts (1/16 oz.) assuming a stroke of 3 in., plus the product of the weight of the reciprocating parts (2 lb.) and the variation in radius of the crankpins (0.010 in.) giving a total of 5 oz.-in.

(9) Variation in the angular position of the crankpins (0.005 in.) also introduces additional unbalance of the reciprocating parts of 0.16 oz.-in.

(10) Additional rotating masses, such as the fan-belt pulley (¼ oz.-in.) the torsion damper (¼ oz.-in.) and the like, introduce additional unbalance.

(11) Generators must be carefully balanced to eliminate high-frequency vibration and beat notes.

(12) Water pumps and fans also should be balanced in some cases to eliminate vibrations and beat notes.

(13) Propeller shafts must be balanced to prevent "whirling," with attendant vibration.

(14) Wheel balance often causes tramp and shimmy. Wheels must be balanced and should be checked as the tires wear.

If each of these unbalances comes on the wrong side of the limit, the unbalance in the assembled engine will be 9½ oz.-in. at the rear end and 3½ oz.-in. at the front. An unbalance of 9½ oz.-in. produces a shaking force of 200 lb. acting on the engine of a car running at 70 m.p.h. This condition is indeed alarming.

In view of the fact that, with the engine mountings and body mountings being used at present, 2 oz.-in. of unbalance is annoying, it is obvious that the foregoing engine would be very disagreeable. Of course, the laws of probability will see to it that not very many engines will be assembled with all of the unbalance on the same side.

Application of Imagination

THE engineer is sunk who relies on the laws of nature and neglects the more involved, and hence less understood, laws of human nature. What fields are open to the young engineer entering the automotive industry? Design, research, operation and maintenance, production and general industrial adviser may be mentioned as a few. In each of these imagination is a primary requisite.

Imagination in Design

As a teacher of engineering design for many years I always regarded with a certain amount of hopelessness the student who confined himself to learning the textbook by rote. I urged students to develop their imaginations by studying with their own eyes and minds the mechanisms under consideration, to attempt to visualize the suitability of their component elements to serve efficiently their intended function. When a design project was undertaken, I insisted first of all that each man prepare a sketch of the machine as a whole, thus portraying his conception of its entirety and the proportionality of its parts.

Experience showed that only when that sketch was acceptably completed was it profitable for the student to work out the details of his design and check by formulas the proportions, sizes and strength factors of its parts, all of which were sketched before calculation. The man who cannot produce a reasonably correct design in a given field without resorting to formulas in a big way will not without further experience and training succeed as a designer in that field. With rare exceptions, design formulas convey little to the mind of the successful and experienced designer except a confirmation of his confidence in his mental picture of size, proportion and relationships. The application of such fundamental rules does, however, serve a most useful purpose in convincing others, less familiar with the subject or less imaginative, in advance of reduction to practice, that a design will function properly.

Imagination in Research

The research worker who has learning without imagination is like a fellow "all dressed up with no place to go." While design is dealing with known elements, research is primarily concerned with exploration of the unknown, a task in which imagination is the only incentive and the only guide. That the imagined goal is frequently not attained is unimportant. The important thing is that imagination has led the research worker into realms of hitherto unknown fact or theory; while there he is certain to discover something new. At any rate, he certainly would never have discovered anything if he had not started. Columbus never discovered the northwest passage to India, which was the dream which led him to venture into uncharted seas, in three small boats, with inadequate means either of navigation or food storage for a long voyage. But he found America, which no one knew was there. We do not even want the stereotyped methods of thought in these new regions. Kipling wrote in one of his recent stories dealing with the possibilities of medical advance: "Imagination is what we want. This rigid 'thinking' game is hanging up research. . . . It is becoming all technique and no advance." And again: "The main point is that it makes one—not so much think—Research is gummed up with thinking—as imagine a bit."

Man in his search has discovered much about the elements of the world which surround us, and has gone far in his analysis of their nature. But I believe that the young men of this generation, who at the very outset of their careers have had to undergo the discipline of a depression, whose wits have been sharpened by the difficulty of the economic situation which confronts them, are especially well equipped to make notable progress in advancing the outposts of human knowledge.

—Excerpts from a 1934 Washington Section paper by C. B. Veal, Research Manager of the Society.

Engine Lubrication with Different Bearing Metals; Especially, Copper-Lead Alloys

By C. M. Larson

Supervising Engineer, Sinclair Refining Co.

WITH the advent of light motor-oils, S.A.E. 10-W and S.A.E. 20-W and the introduction of copper-lead bearings in passenger-car and motor-truck engines, new lubrication-factors have arisen with respect to motor-oil stability as well as with respect to the nature of compounds used for the breaking-in period.

This paper describes a series of tests which were run using S.A.E. No. 11 babbitt bearings and lead-copper and leaded bronze bearings. The relative extreme-pressure characteristics of the various motor-oils, both mineral and compounded, were recorded. In addition, the coefficients of friction were plotted as ordinates (f) and the viscosity, angular speed and pressure (ZN/P) as abscissas were correlated. For this phase of the work, test apparatus had to be developed.

The effect of the mineral and compounded motor-oils on the bearing metals and the causes of deterioration, and vice versa, and the effect of the bearing metals on the stability of the motor oils were checked.

The summation of the data shows that certain metals cause some mineral oils to deteriorate more readily than others and that high acidity in motor-oils causes not only more rapid decomposition of the lubricants themselves but of the bearing metals as well. The coefficient of friction varies with the different metals and with the different combinations of compounds.

THE publicity campaign waged by the Society, recommending lighter oils, has borne fruit. Fig. 1 shows that the twelve years of discussion between refiners and automotive engineers relative to the advantages of heavy versus light oils has been broken. The use of an S.A.E. 10-W motor-oil and S.A.E. 20-W motor-oil having an S.A.E.-30 rating at the higher temperatures will be the leading grades by 1936.

Now that low consumption with lighter oils is possible within practical bounds, the automotive engineer is investigating the replacement of babbitt with new types of bearing metals; namely, with copper-lead and leaded-bronze bearings. These and other "New-Deal" lubrication-factors have arisen with respect to automotive-engine-lubrication motor-oils, especially with relation to stability and the nature of "oiliness" compounds used for the break-in period. Experience has shown that the bearing material must be strong enough to support the load as well as any bending stresses in the shaft, and to prevent the bearing metal from cracking or flowing out (wiping) under maximum pressures due to load on the shaft.

A series of tests was first run on various S.A.E.-viscosity-numbered oils to see what effect the reduction in viscosity had on the failure temperature of the bearing metal. The test machine, shown in Fig. 2, used for this investigation, consists of a shaft A rotated at a constant speed and means B for applying a known load. The shaft is of rigid construction. The journal, bearing the load, is 1 in. in diameter and ground to size. A half bushing C (Pb. 85; Sn. and Sb. 14; Cu. 0.5 bearing metal) is in contact with the journal. Load is applied by means of a lever and suitable weights. Each bushing is 1 in. long so that 1 sq. in. of projected area carries the load. The lubricant is fed from a cup D

[This paper was presented at the Semi-Annual Meeting of the Society, Saranac Inn, N. Y., June 20, 1934.]

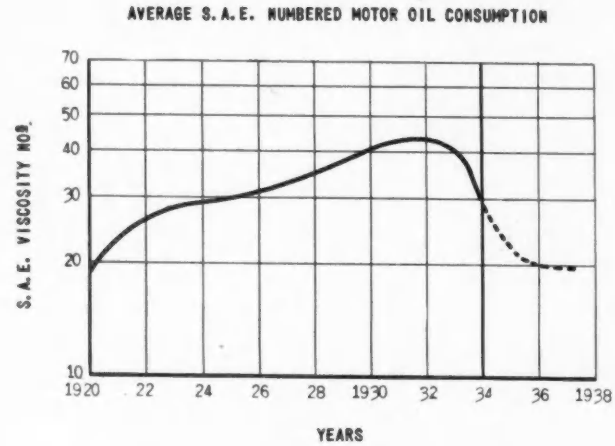


Fig. 1—Advantages of Heavy versus Light Oils

at a rate of about 16 drops per min., and, after passing through the bearing, flows down the sides of the link through troughs. The troughs *E* are made of copper, and, should stains occur, some detrimental property in that particular oil is indicated.

Using the same load, the stable temperature rise was taken as indicative of the lubricating qualities of the oil under test. Failure of the bearing metal is due to pressure and temperature. The metal can be made to flow at room temperatures should the pressure exceed the elastic limit, or, conversely, should the temperature approach the melting point of the metal, a small pressure will wipe the bearing. Therefore, temperature is the main limiting factor in the carrying of high unit bearing-pressures. In this test the temperature is determined by means of a thermocouple *F* having the hot junction in a copper block which rides on the shaft at the middle of the journal bearing. Tests have shown that there is a difference of less than 2 deg. fahr. between the temperatures obtained with this arrangement and those obtained with the hot junction embedded in the bearing metal at the point of greatest load. The present method is also more convenient for the reason that, when the bearing metal flows at point of failure, the wires are often broken while being removed from the ruined bushing.

Fig. 3 is a graphic presentation of the extreme-pressure viscosity temperature-curves of various S.A.E.-viscosity-numbered oils. The S.A.E. 10-W oil had a Saybolt-universal viscosity of 470 sec. at the initial bearing temperature of 56 deg. fahr. After applying a load of 250 lb. per sq. in. on the bearing, the temperature reached, after approximately 30 min., was 64 deg. fahr. and the Saybolt-universal viscosity was 320 sec. A 500-lb. per sq. in. load caused the temperature to rise 74 deg. fahr. and thinned the oil down to 225 sec. Further increasing of the load resulted in a more rapid reduction in viscosity due to the relatively increased rate of temperature rise, so that, at 750-lb. per sq. in. load, the viscosity had dropped to 89 sec. at a temperature of 110 deg. fahr. At a temperature of 115 deg. fahr. and a load slightly exceeding 800 lb. per sq. in., the bearing wiped because the oil film of 80-sec. viscosity failed under the extreme pressure. For each load determination a new bearing-metal ground bushing was used to avoid initial clearance variation and guarded against increase in the area of bearing-surface contact.

The S.A.E. 20-W and S.A.E.-30 motor-oils followed much the same trend; but, for an equivalent viscosity, the S.A.E.-30 oil carried a greater load per square inch than did the S.A.E. 20-W oil. The S.A.E. 20-W oil also exceeded the S.A.E. 10-W oil. The S.A.E.-30 oil carried a load up to 2400 lb. per sq. in., whereas the S.A.E. 20-W oil was restricted to 1350 lb. Compared at 100-sec. viscosity the loads per square inch carried were 780 lb. for the S.A.E. 10-W oil, 1230 lb. for the S.A.E. 20-W oil, and 2250 lb. for the S.A.E.-30 oil.

It is interesting to note that the S.A.E.-40 oil was too heavy to feed properly into the bearing, so that, until a viscosity of approximately 2500 sec. was reached, small increases in the load caused the bearing temperature to rise at a faster rate. Below this viscosity, much greater loads were carried with less bearing-temperature rise and consequently less thinning of the oil. The failure point exceeded 2700 lb. per sq. in. at a viscosity of 55 sec., or 250 deg. fahr. At 100-sec. viscosity, S.A.E.-40 oil carried a load of 2650 lb. per sq. in.

By taking the S.A.E. 10-W oil and adding a fixed oil compound, it was possible to produce an oil of better viscosity index than the S.A.E. 10-W oil. This oil, see Fig. 3, has far greater load-carrying capacity than the S.A.E. 10-W oil, carries higher loads at high temperatures, and more nearly approaches the S.A.E.-No. 30 oil.

In order to compare babbitt and copper-lead bronze bearing metals, the first set of bushings of S.A.E. No. 11 babbitt, metal *A* (tin 89, copper 5, antimony 5, lead 0.35) and of copper-lead bronze, metal *C* (copper 67, tin 2, lead 30 and nickel 1) were made for further testing. Runs were made using S.A.E.-30 and 10-W motor-oils.

Fig. 4 shows the stable bearing temperature plotted against

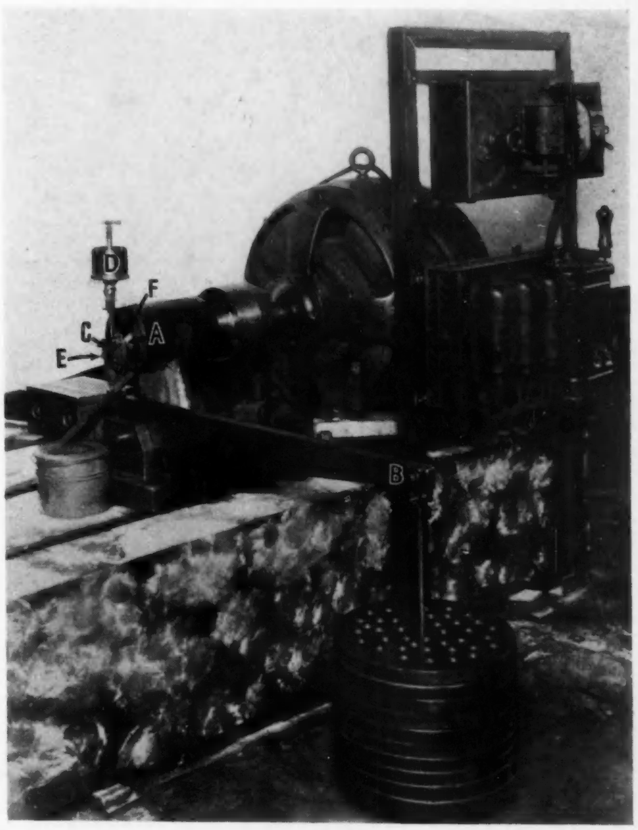
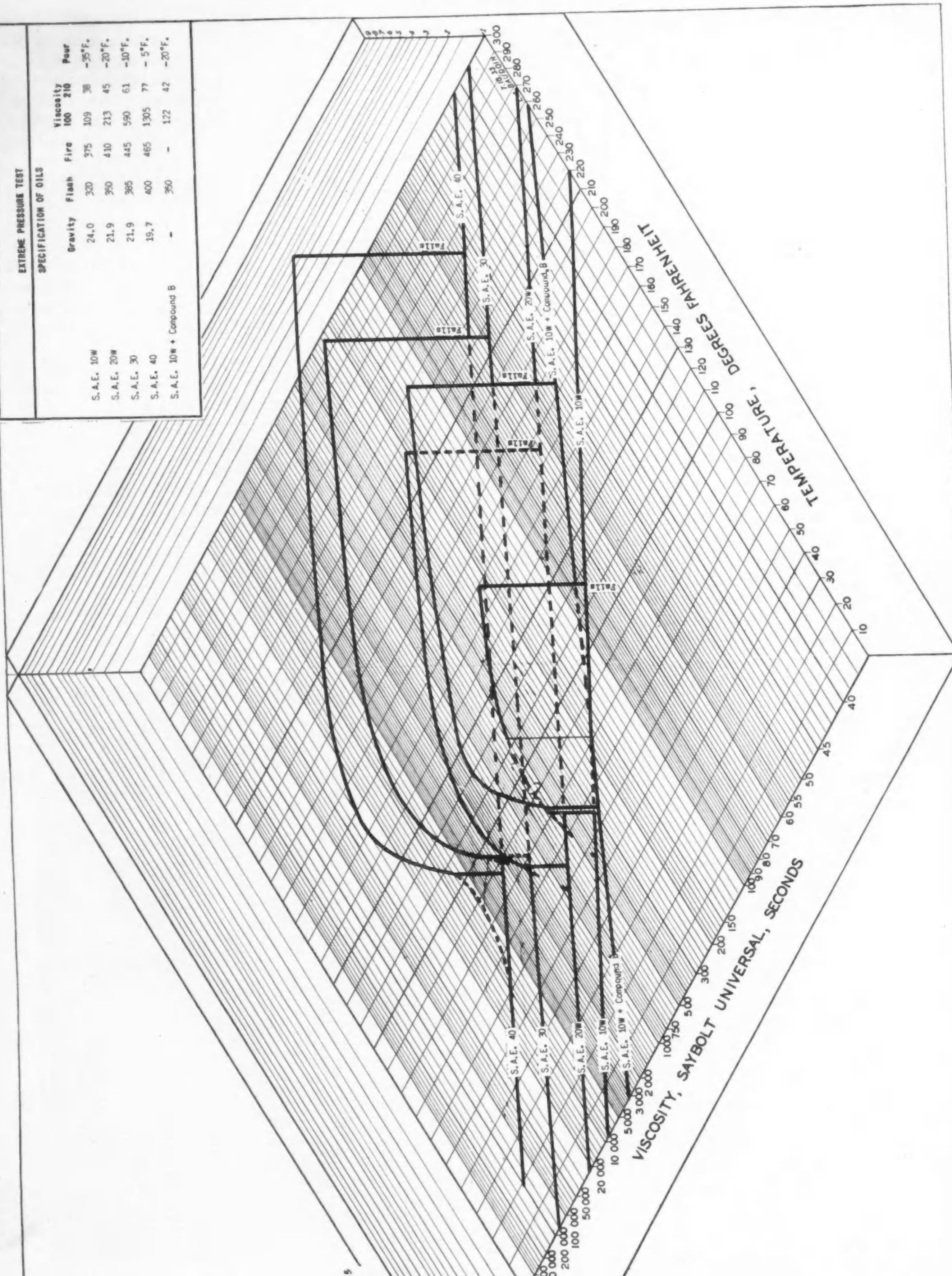


Fig. 2—Sinclair Refining Co. Extreme-Pressure-Lubricant Testing-Machine



EXTREME PRESSURE TEST

SPECIFICATION OF OILS

	Gravity	Flash	Fire	Viscosity 100	Viscosity 210	Pour
S.A.E. 10W	24.0	320	375	109	38	-35°F.
S.A.E. 20W	21.9	350	410	213	45	-20°F.
S.A.E. 30	21.9	385	445	590	61	-10°F.
S.A.E. 40	19.7	400	465	1305	77	- 5°F.
S.A.E. 10W + Compound B	-	350	-	122	42	-20°F.

Fig. 3—Extreme-Pressure-Lubricant Viscosity-Temperature Chart

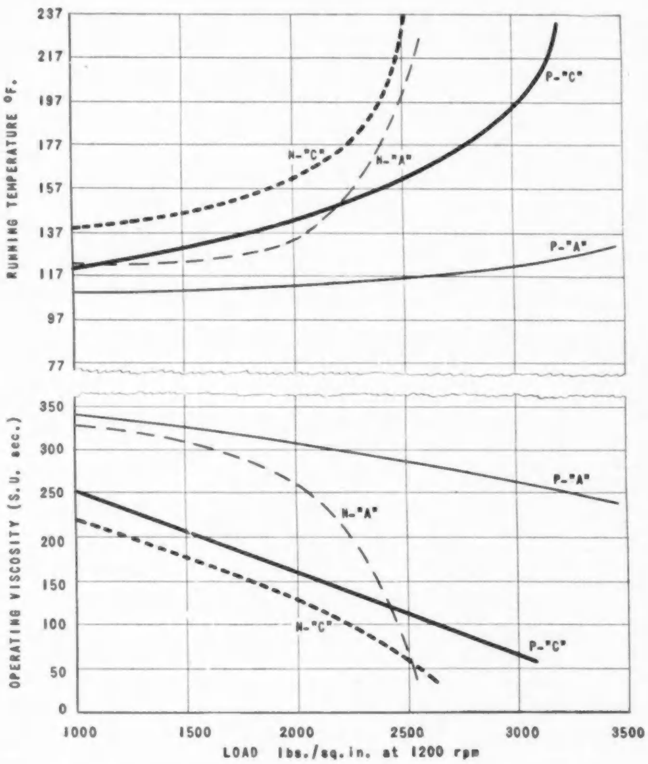


Fig. 4—Stable Operating Temperatures and Viscosities for S.A.E.-30 Oils at Various Loads with Bearing Metals "A" and "C"

For P = P—S.A.E.—30 Oil and N = N—S.A.E.—30 Oil. "A" = S.A.E. No. 11 Babbitt and "C" = Copper-Lead Bronze Metal "C" (Cu. 67; Sn. 2; Pb. 30; Ni. 1).

the actual load in pounds per square inch and the resulting viscosity for the various loads when S.A.E.-30 oils are fed to the copper-lead bronze bearings *C*.

Fig. 5 is a similar plot for S.A.E. 10-W motor oils. This set of copper-lead bronze bearings *C* shows a greater tendency to overheat than do the S.A.E. No. 11 babbitt bearings.

Fig. 6A shows the data in Fig. 4 plotted on the isometric chart for viscosity, temperature and pressure. Fig. 6B is similar to Fig. 6A, from Fig. 5, for S.A.E. 10-W motor-oils.

There is a decided advantage in using high-viscosity-index oils, especially when S.A.E. 10-W oils are used with copper-lead bronze bearings, *C*.

In the study of bearing friction, the performances of the bearing metals were indicated graphically by plotting the coefficient of friction f against the generalized operating variable ZN/P, where Z is the absolute viscosity of the lubricant expressed in centipoises, N the speed of the journal in revolutions per minute and P the bearing pressure in pounds per square inch of projected area.

The friction machine shown in Figs. 7 and 8 is an improvement over that shown in Fig. 2 in that the bearing metal is carried in a hardened-steel cradle supported on rollers. This assembly rests on a swivel block mounted on the loading lever. The steel cradle which carries the bushing also carries a balance torque-arm that bears on a stirrup registering in pounds on a sensitive scale. The shaft is provided with roller bearings to reduce radial displacement regardless of the load on the journal. All lateral thrust is controlled by the ball bearings of the motor drive. The shaft-bearing housing is water jacketed to aid in controlling the temperature of the shaft at high speed and under heavy loads. The shaft and journal are turned by means of a four-speed direct-connected motor. A small motor, driving through a reduction gear and belted to a coupling between the motor and shaft, provides two additional extremely slow speeds. A special scale is provided to measure the turning effort of the bushing in 0.01-lb. increments. The linkage is such that there is an extremely small movement of the torque-arm at maximum deflection.

When investigating the ZN/P versus f characteristics of the oil or bearing metal, the higher speeds—for example approximately 450, 600, 900 and 1200—are used for the portion of the curve within the zone of good lubrication under flooded conditions. The conditions at the transition point are examined at a speed of 44 to 46 r.p.m., whereas the conditions at the left of the transition point are determined at slower speeds, say 5 to 6 r.p.m.

Fig. 9 shows the f versus ZN/P curves for loads of 250 to 1500 lb. per sq. in. at a constant speed of 43 r.p.m. at a constant temperature of 77 deg. fahr. for the second set of bushings of S.A.E. No. 11 babbitt and of the copper-lead *B* bearings (copper 53.45; lead 44.37; nickel 2.15). The oils are the same S.A.E.-30 oils used in Fig. 4. At the transition point, these copper-lead *B* bearings give lower coefficients of friction than for the S.A.E. No. 11 babbitt.

Fig. 10 shows the effect of the addition of 2 per cent of fixed oil compound SW to N-S.A.E.-30 oil. The fixed oil showed very little improvement for the babbitt, but a marked improvement when used to lubricate the copper-lead *B* bear-

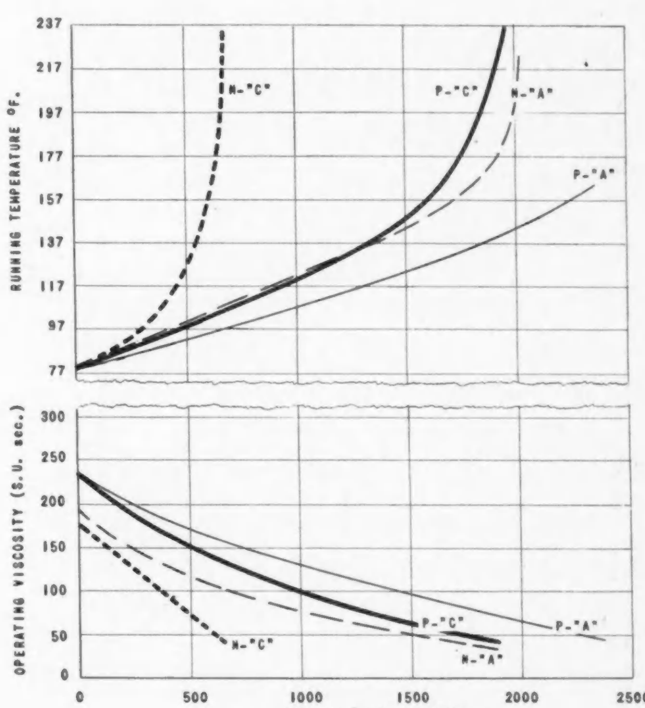


Fig. 5—Stable Operating Temperatures and Viscosities for S.A.E. 10-W Motor-Oils at Various Loads with Bearing Metals "A" and "C"

For P = P—S.A.E. 10—W Oil and N = N—S.A.E. 10-W Oil. "A" = S.A.E. No. 11 Babbitt and "C" = Copper Lead Bronze Metal "C" (Cu. 67; Sn. 2; Pb. 30; Ni. 1).

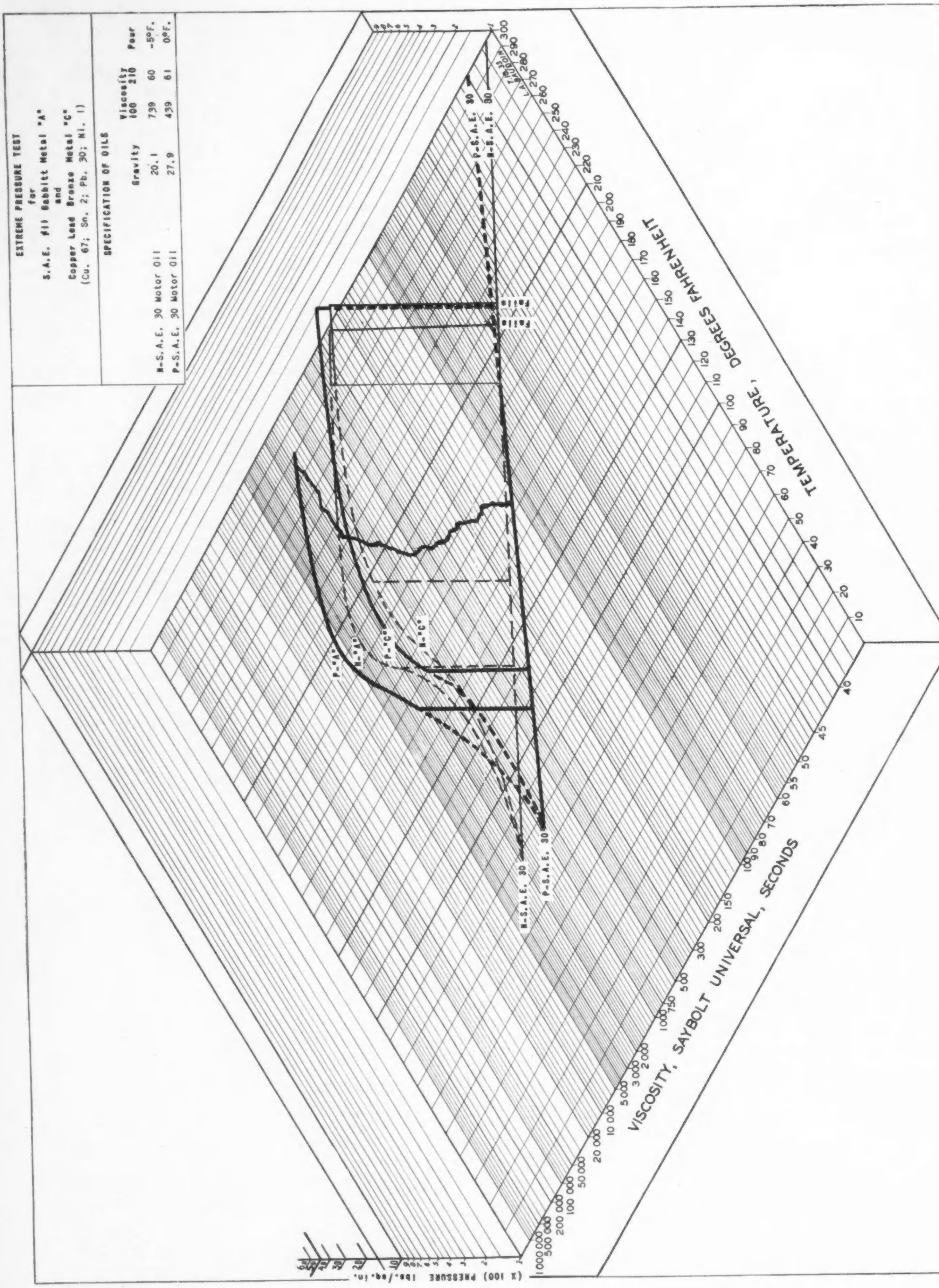


Fig. 6A—Extreme-Pressure-Lubricant Viscosity-Temperature Chart for S.A.E.-30 Motor-Oils

Fig. 6A—Extreme-Pressure-Lubricant Viscosity-Temperature Chart for S.A.E.-30 Motor-Oils

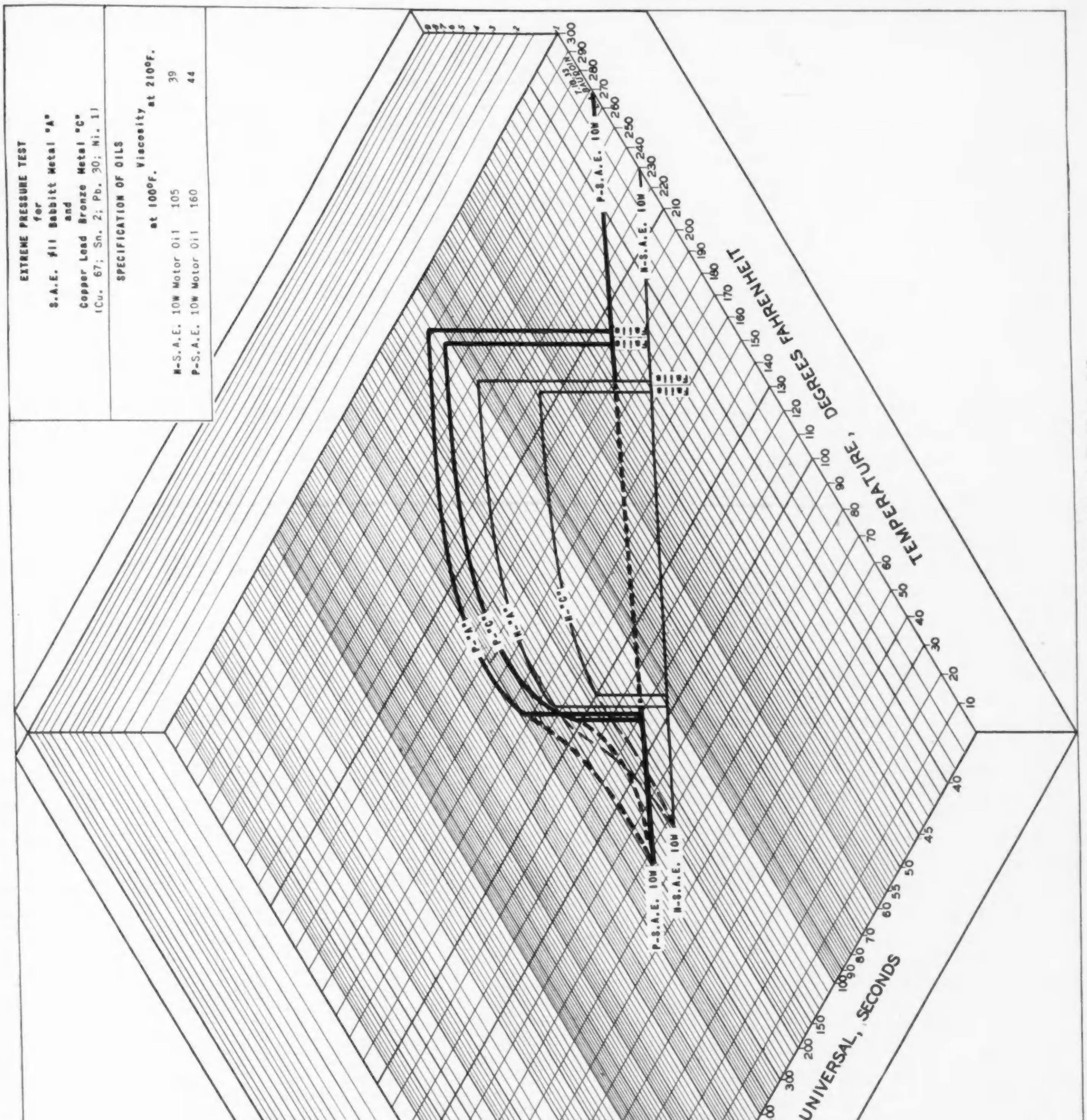


Fig. 6B—Extreme-Pressure-Lubricant Viscosity-Temperature Chart for S.A.E. 10-W Motor-Oils

Table 1—Results of Keeping Bearings Hot in Sludged Oil

	P-S.A.E.-30 Oil			O-S.A.E.-30 Oil			N-S.A.E.-30 Oil		
	Sludged Oil	Copper-Lead Bushing Boiled at: Deg. Fahr.		Sludged Oil	Copper-Lead Bushing Boiled at: Deg. Fahr.		Sludged Oil	Copper-Lead Bushing Boiled at: Deg. Fahr.	
		210	320		210	320		210	320
Carbon Content	1.00			1.13			2.08		
Neutral No.	0.39	.42	.64	0.59	.50	.84	0.62	.70	2.10
Lead, per cent	0.00	0.09	0.20	0.00	0.17	0.11	0.00	0.22	0.21
Insoluble in 86-deg. Naphtha	0.09	0.05	1.95	0.74	0.70	3.56	1.94	1.86	5.80
Calculated lead removed from bearing, in.		0.0001	0.0002		0.00019	0.00012		0.00025	0.00024

ing, although the straight mineral oil P-S.A.E. 30 was equally as efficient as the compounded N-S.A.E. 30 on the copper-lead *B* bearing and better with respect to the babbitt bearing.

A further study of various S.A.E.-30 motor-oils compounded with 2 per cent of various fatty oils (Fig. 11) was undertaken to see the effect of the compounds on the lowest coefficient of friction values with a 500-lb. beam-load. The relative differences of the two types of bearing metals and the compound effect on the three S.A.E.-30 mineral-oils shows that certain compounds have a decided effect both on the babbitt and the copper-lead *B* bearings. In every instance, the compounded and straight mineral oils gave better results on the copper-lead *B* bearings than on the babbitt, but certain fatty oils raised the coefficient of friction over that of the straight mineral oil. The same relative effect was recorded at a 1000-lb. beam-load (Fig. 12). Copper, nickel and antimony act catalytically to accelerate decomposition of certain fatty oils.

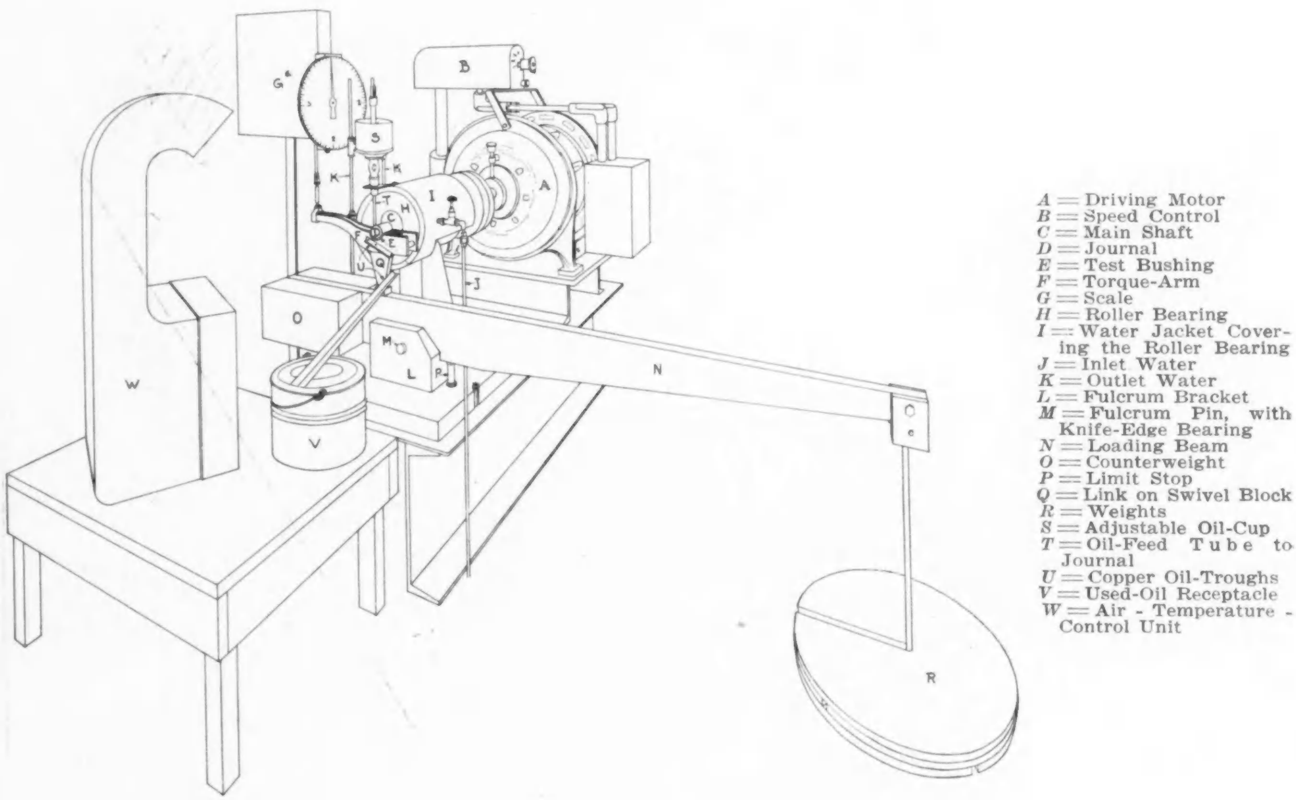


Fig. 7—Diagrammatic View of the Friction Machine

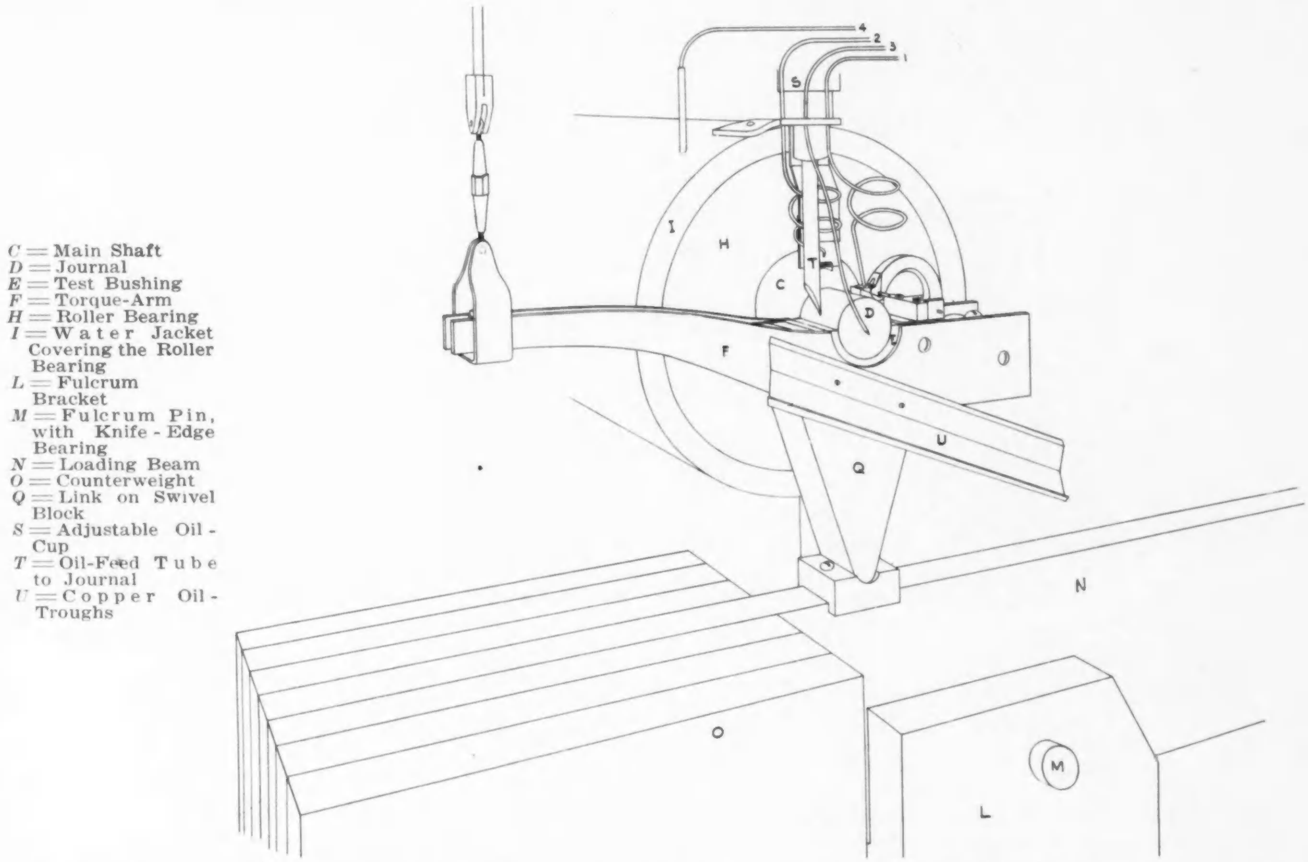


Fig. 8—Further Details of the Friction Machine

The thermocouples are located at (1), for the journal, *D*; at (2), for the main shaft, *C*; at (3), for the air surrounding *C* and *D*; and at (4), for the water jacket, *I*.

To check the possible lead pick-up of used motor-oils when in contact with copper-lead bearings, three S.A.E.-30 motor-oils were sludged at 280 deg. fahr. for 125 hr. The copper-lead *B* bearings were kept hot in this sludged oil, one series at 210 deg. fahr. for 120 hr. The results are given in Table 1.

The lead-copper-nickel bearings, when examined after the

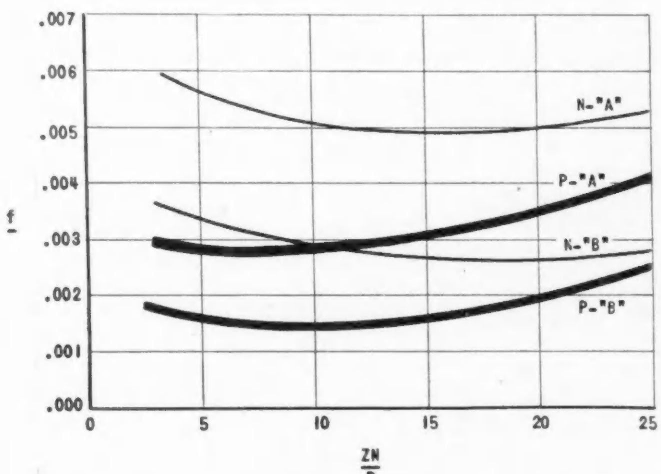


Fig. 9—Journal-Friction Curves at a Constant Speed of 46 R.P.M. with Loads of 250 to 1500 Lb. Per. Sq. In. for Metals "A" and "B" and for N-S.A.E.-30 and P-S.A.E.-30 Oils

For P = P—S.A.E.—30 Oil and for N = N—S.A.E.—30 Oil. "A" = S.A.E. No. 11 Babbitt and "B" = Copper-Lead Bearing Metal.

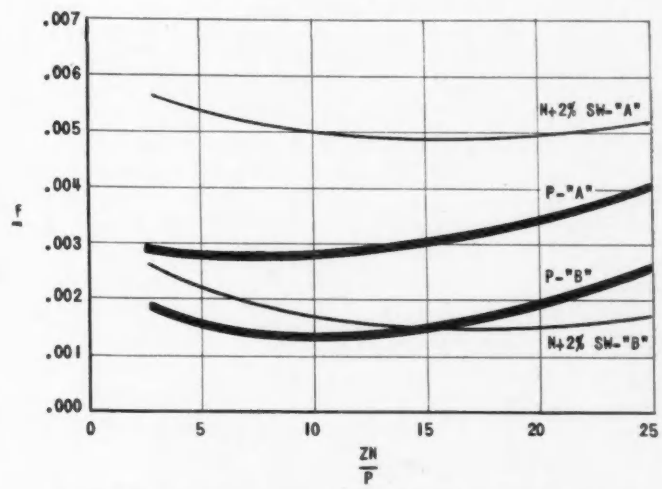


Fig. 10—Journal-Friction Curves at a Constant Speed of 46 R.P.M. with Loads of 250 to 1500 Lb. Per Sq. In. for Metals "A" and "B" and for N-S.A.E.-30 Plus 2 Per Cent SW and P-S.A.E.-30 Oils

For N = N—S.A.E.—30 Oil, for N Plus 2 Per Cent SW = N—S.A.E.—30 Oil Plus 2 Per Cent Compound SW, and for P = P—S.A.E.—30 Oil. "A" = S.A.E. No. 11 Babbitt and "B" = Copper-Lead Bearing Metal.

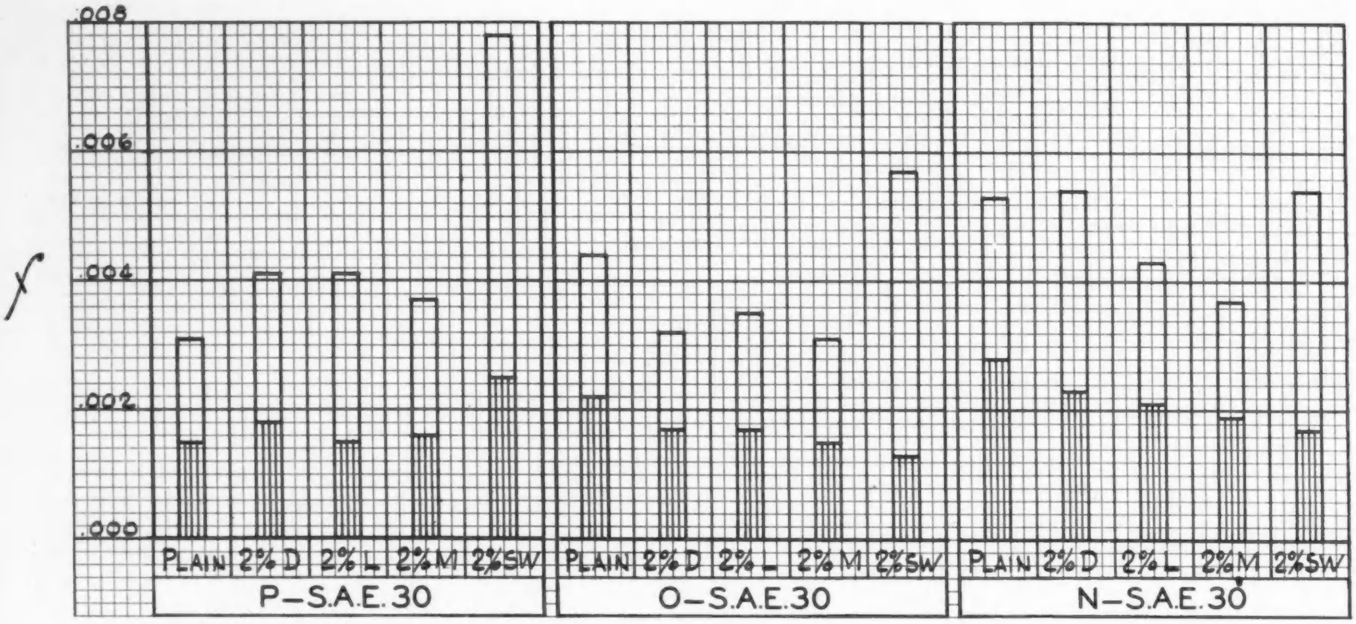


Fig. 11—Lowest Coefficient of Friction Values with a 500-Lb. Beam-Load for S.A.E.-30 Oils with the Addition of Various Fixed Oils Using Bearing Metals "A" and "B"

The total blocks represent S.A.E. No. 11 Babbitt "A." The shaded portion of the blocks represent Copper-Lead Bearing Metal "B" (Cu. 53.45; Pb. 44.37; Ni. 2.15)

foregoing treatment, showed that the sludged N-S.A.E.-30 oil attacked the lead and uncovered the copper, resulting in a dark appearance. Also, the sludge and lead pick-up were greatest with the N-S.A.E.-30 oil and least with P-S.A.E.-30 oil.

Three of the copper-lead bushings were run on the friction-testing machine shown in Fig. 7 with new oil, then placed in oil that had been artificially sludged for 125 hr. and held at 210 deg. fahr. for 100 hr. A second set was then run on the friction-testing machine, as before, and then placed in the sludged oil; but, this time, the bath was maintained at 320 deg. fahr. for 120 hr.

Although these bushings were discolored and lost a portion

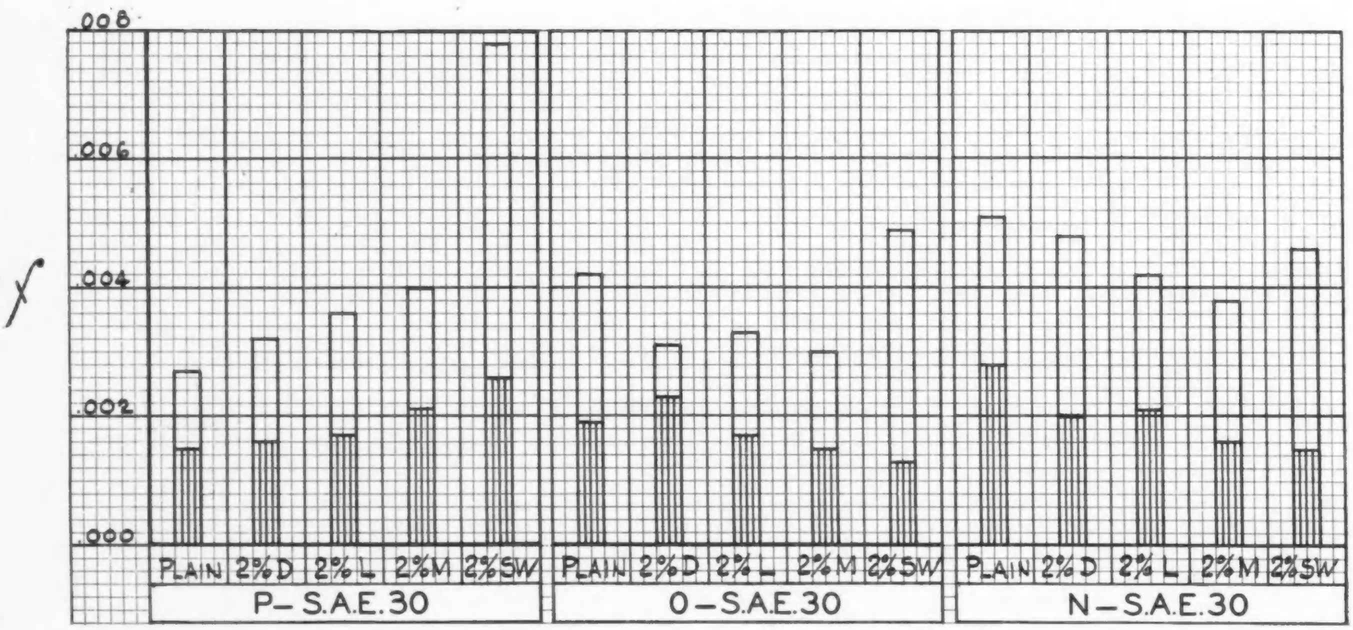


Fig. 12—Lowest Coefficient of Friction Values with a 1000 Lb. Beam-Load for S.A.E.-30 Oils with the Addition of Various Fixed Oils Using Bearing Metals "A" and "B"

The total blocks represent S.A.E. No. 11 Babbitt "A". The shaded portion of the blocks represent Copper-Lead Bearing Metal "B" (Cu. 53.45; Pb. 44.37; Ni. 2.15)

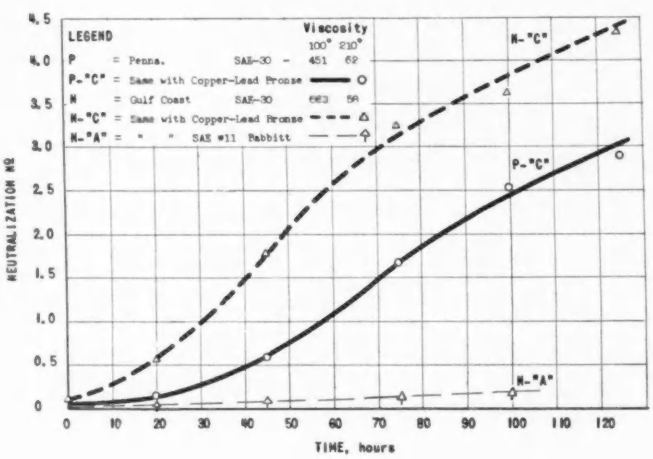


Fig. 13—Effect of Copper-Lead Bronze versus S.A.E. No. 11 Babbitt on Oils Held at 245 Deg. Fahr. Neutralization Number versus Hours

of the lead content, no serious damage was done, the reason being that, when treated bushings were re-run on the friction-testing machine with new oil, the points developed fell almost exactly upon the curves previously plotted for new bushings and new oil. The rapid sludging of the oils, however, would be detrimental to lubrication with oil O-S.A.E. 30 and especially so with N-S.A.E. 30, when used over high-speed summer driving-conditions.

The relative sludging tendencies of motor-oils were checked further in the 125-hr. test on oils held at 245 deg. fahr., using S.A.E. No. 11 babbitt chips immersed in the heated oil-stream as against bearing metal *C*, copper-lead chips. Fig. 13 shows that, with S.A.E. No. 11 babbitt, N-S.A.E.-30 oil at the end of 100 hr. had a neutralization number of 0.18, having increased slightly from 0.03; whereas the same oil with copper-lead *C*, increased to 3.8 neutralization number. Oil P-S.A.E. 30 showed similar results, but not as great as N-S.A.E.-30 oil.

Fig. 14 is plotted for insoluble in 86-deg. naphtha and again shows that the N-S.A.E.-30 oil with babbitt has very little sludging tendencies; but, when copper-lead *C* is introduced, the sludge percentage increases to 2 per cent. P-S.A.E.-30 oil

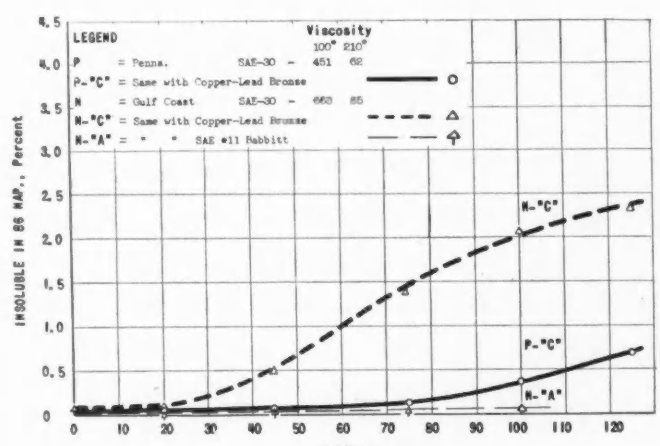


Fig. 14—Effect of Copper-Lead Bronze versus S.A.E. No. 11 Babbitt on Oils Held at 245 Deg. Fahr. Percentage Insoluble in 86-Deg. Naphtha versus Hours

is more resistant against sludging with copper-lead, showing only 0.35 per cent as against 2.0 per cent with N-S.A.E.-30 oil.

The effect on viscosity is shown in Fig. 15. With S.A.E. No. 11 babbitt, N-S.A.E.-30 oil increased from 663 sec. at 100 deg. fahr. to 1360 sec. at the end of 100 hr. Oil P-S.A.E. 30 showed a 40-per cent increase in viscosity; whereas, oil N-S.A.E. 30 increased 104 per cent.

Another oil-stability test now under way is the 100-hr. Navy work-factor test to check the breakdown with copper-lead bearings as compared with babbitt bearings.

It is a well known fact that 1 per cent of carbon tetrachloride added to an oil will increase its load-carrying capacity when used to lubricate steel on steel; yet, when used to lubricate copper-lead bearings, the action becomes so harsh that the bearing fails at a much lower load or temperature

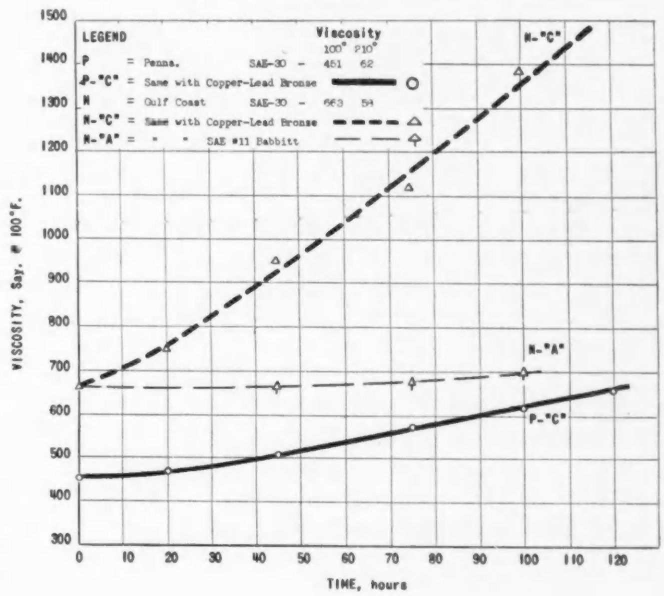


Fig. 15—Effect of Copper-Lead Bronze versus S.A.E. No. 11 Babbitt on Oils Held at 245 Deg. Fahr. Viscosity at 100 Deg. Fahr. versus Hours

than with the straight mineral oil. By cutting down the carbon tetrachloride to 0.04 per cent, a marked improvement is shown. In the case of sulphur chloride of the type used for extreme-pressure transmission-lubricants, good results require the amount used to be limited to 0.005 per cent. In attempting to promote extreme-pressure motor-oils and break-in oils, special precaution must be taken if copper-lead bearing metals are employed. It is regretted that, up to this time, this project has been only two-thirds completed. The tests seem to discredit certain copper-lead-bronze mixtures, especially if compared under operating-service conditions. Babbitt bearings are favored where, with oil coolers, crankcase temperatures are kept below 170 deg. fahr. However, at high temperatures the coefficient-of-friction differences between babbitt and copper-lead-bronze bearings become unnoticeable.

Regardless of the "don'ts" and the necessity for motor-oils of higher stability, copper-lead bearings—properly run-in—are coming into use fast because actual service has indicated longer bearing life and elimination of cracked bearings as mileage piles up on the engine.

Forced-Induction Possibilities for Automotive Vehicles

By Louis Schwitzer

President and Chief Engineer, Schwitzer-Cummins Co.

IT is always the automotive engineer's endeavor to improve automotive vehicular performance. Greater acceleration and higher speeds have been accomplished by a continuous increase of engine sizes, until today further increase by this method is not logical.

We are today turning to dual axle ratios and streamlining to accomplish further increases; the former to allay the disastrous effects of the drooping torque-curve at high engine speeds, and the latter to reduce the power to propel the vehicle.

Reduction of engine-speed wheel-speed ratios is ideal for high speed but represents a loss in acceleration at intermediate speeds. Reduction of wind resistance of the vehicle, only valuable at high speeds, permits only a slight increase in top speed because of the rapid reduction in power at high engine speeds.

Thus a dilemma exists, which can be avoided by forced induction, or supercharging. Forced induction with dual axle ratios and streamlining produces the only complete picture.

Of three general types of compressors adaptable to automotive engines—the vane, Roots, and centrifugal types—the last is best adapted for present-day engines. Actual tests show, in addition to a remarkable improvement in performance, a sizable reduction in specific fuel consumption.

Centrifugal compressors are least expensive, most silent, involve the fewest problems, have the greatest production possibilities, and can be adapted to present engines in a number of satisfactory ways.

EVER since the automotive vehicle has reached the commercial stage of development, it has been the engineers' ambition to improve its performance. Reliability has become a matter of course with improvements in design and materials. Performance has been largely the result of increased engine power. This has been achieved until lately by increasing engine sizes until they have reached the limit permissible through size, weight and fuel consumption. Economy, particularly, has become a factor of importance.

The engineer has in this endeavor always reached his nemesis by the drooping torque-curve and, consequently, falling of horsepower developed in engines at usable engine speeds. To reduce engine speeds at increased car top-speeds, four-speed transmissions, dual rear-axle ratios, overdrives, and other means have been resorted to. The purpose of this development was to increase top speed by intersecting road-load and peak-power curves at the most favorable points.

Since road speeds have reached the aerodynamic level, teardrop or streamline cars have become attractive because they represent a sound engineering advancement. Many states have no speed-limit laws and the car user can drive legally at high speed. The roads and their warning signs are so uniformly good that high speeds are safer today than 30 m.p.h. was ten years ago. What the top speeds will be or whether it will be a front, rear, or midship-engined car, it is not my purpose to discuss.

I wish to illustrate first the advantages gained by reducing present wind resistance to one-half, then to consider the limitations due to weight, engine speed-range and acceleration of such a car, and, later, how this performance can be improved by forced induction, generally known as supercharging.

In a paper[1] entitled "Wind Resistance versus Car Performance," I stressed the importance of streamlining because of the rapid increase in car speed. The amount of energy used to overcome wind resistance only is so great that it precludes sufficient power remaining for satisfactory acceleration and hill-climbing ability. Some of the figures which will be shown are convincing. However, they point out that further engine development is necessary before the full advantages of streamlining can be enjoyed. The appearance of so-called

[This paper was presented at the Semi-Annual Meeting of the Society, Saranac Inn, N. Y., June 21, 1934.]

[1] See S.A.E. JOURNAL, June, 1931, p. 631.

Table 1—Specific Wind-Resistances[a]

Speed, M.P.H.	Horsepower Per Square Foot of Projected Frontal Area K=0.0022	K=0.0011	K=0.00055
10	0.005	0.0025	0.0012
15	0.020	0.010	0.005
20	0.046	0.023	0.011
30	0.158	0.079	0.039
40	0.373	0.186	0.093
50	0.733	0.366	0.183
60	1.250	0.625	0.312
70	2.015	1.007	0.503
80	3.000	1.500	0.750
90	4.270	2.135	1.067
100	5.860	2.930	1.465
110	7.800	3.900	1.950
120	10.150	5.075	2.537
130	12.800	6.400	3.200
140	16.100	8.050	4.025
150	20.000	10.000	5.000

[a] In Fig. 1, K=0.0022 and K=0.0011. We have also, $WR=KAV^2$ and Hp.$=KAV^3$.

streamlined cars is not offered any more as the chief objection. They have arrived, and will become more and more popular.

Table 1 indicates the horsepower required per mile per hour per square foot of frontal area at K factors, respectively, of 0.0022, 0.0011 and 0.00055. This K factor is difficult to define, but it is readily understandable when reference is made to the fundamental wind-resistance formula.

The wind resistance, WR, of a body moving in air may be evaluated as a product of a constant—depending upon the body shape—K, its projected frontal area, A, and the square of its velocity, V^2. Windage horsepower required is the product of wind resistance and velocity, or Hp. $= (KAV^2) V$, or KAV^3. Recent research has indicated that the K factor of a given body is not constant over a wide range of speeds. It has also been found, likewise, that the power requirement does not vary exactly as the cube of the velocity. A long mathematical discourse would be necessary to investigate how two variables, K and V^3, which are always used together, can be analyzed for their individual characteristics. However, the fundamental formula is generally used and was used in this treatise, as is undoubtedly correct within experimental error.

Actual tests on the Indianapolis Motor Speedway and computed comparative performance of cars of different size indicate that the low-powered streamlined-car is uncommercial. (Fig. 1.) Body lengths are limited by the devastating effect of cross-winds on large-side areas at higher road-speeds and by parking limitations for city driving. Automotive streamline bodies cannot be compared with aircraft because, in the case of aircraft, the body can be headed favorably into the wind while traversing a distance between two points when the wind is not in line with these two points. An automobile must, however, head the direction of the road, irrespective of cross-wind directions. A normal car, if streamlined, has noticeably better acceleration above 50 m.p.h. but will gain only about 5 per cent in top speed. Although the top speed may be increased by changing the gear ratio, it will be followed by a loss in acceleration. From the curve, it should be evident that streamlining is of little value below speeds of 50 m.p.h.

To maintain present-day commercial acceleration precludes changing the overall gear-ratio. Therefore, to obtain the higher top-speeds possible with streamlining and maintain present-day low-speed acceleration, the speed range of engines ought to be increased about 20 per cent. In Fig. 1, horsepower instead of torque curves are used, since the problem involves top speed as well as that of maximum acceleration. For simplicity, all computations refer to horsepower at the wheel, or tractive effort. To get the engine horsepower, a transmission loss of 10 per cent is assumed. This means that, to obtain engine horsepower, the indicated power figures should be divided by 0.9.

In Fig. 1, the wind-resistance curve $K = 0.0022$ and $K = 0.0011$ were plotted. The figures for these curves were obtained from Table 1. At each point on the $K = 0.0022$ curve, where it intersects the 10-m.p.h. vertical-line, a horsepower curve is started. The point A is an example, on the 80-m.p.h. line. The curve for K represents wind resistance which must be overcome. The intersection of the horsepower curve and the K curve is the balancing point. It has been found in practice that the peak horsepower must be ahead of this point; otherwise, there will not be sufficient excess power to bring the car up to the balance point, A. When a car is geared so as to peak just at the theoretical balance point, the test results will often vary 5 to 10 m.p.h. For the purposes of this comparison, the horsepower is taken at 95 per cent of the peak for the balance point. This corresponds to 112 per cent of the peak engine-speed. The curves were then plotted to the left from the intersection point, using representative horsepower curves, the peak of each being 100/112 or 89.3 per cent of the balancing speed, while the peak horsepower was 100/95 or 105 per cent of that at the intersection. This curve shows that the maximum excess horsepower and, therefore, maximum acceleration, comes at the intermediate speeds.

Fig. 1—Horsepower versus Speed Curves

From the two *K*-curves, one 50 per cent of the other in value, and the various horsepower curves, one can quickly make comparisons of cars having maximum speeds of from 50 to 140 m.p.h. The latter value checks quite closely with experience on 500-mile-race cars. This also checks closely with the medium-priced passenger-car, which has speeds up to 80 m.p.h. with a frontal area of 30 to 32 sq. ft. and a *K* factor of about 0.002 when powered with engines of 90 to 100 hp.

Further study of the curves in Fig. 1 indicates that (*a*) below 55 m.p.h. something less than 0.5 hp. per sq. ft. can be saved by streamlining; (*b*) from 55 to 70 m.p.h. the saving is from 0.5 to 1.0 hp. per sq. ft., or twice that saved below 50 m.p.h.; (*c*) from 70 to 80 m.p.h. the saving is from 1.0 to 1.5 hp. per sq. ft., or three times that below 50 m.p.h.; and (*d*) from 80 to 90 m.p.h. requires 1½ to 2⅛ hp. per sq. ft., or more than four times that below 50 m.p.h. These figures indicate to car manufacturers and users that only mile-a-minute drivers should be interested in streamlined cars. This is not true with buses and trucks, where the horsepower-frontal-area is much greater.

Most trucks travel between 40 and 50 m.p.h. and have frontal areas of about 100 sq. ft. Such a truck, at 50 m.p.h., would require 73 wheel-hp., or 81 engine-hp., to overcome wind resistance. If this could be halved by proper streamlining, it would mean a saving of at least 40 hp. or approximately 3 gal. of fuel per hr. On a passenger car, the loss is only 10 to 15 hp. because of a smaller frontal area. The engine horsepower of both vehicles probably will be very nearly alike. For comparison, say it is 100 hp. The passenger car only loses 10 to 15 per cent of its power overcoming wind resistance below 50 m.p.h., while the truck loses over 80 per cent. That is why trucks offer just as fertile a field for streamlining as does the passenger car.

Returning to the passenger-car problem in its critical-speed range, most cars today will do 70 and many will do 80 m.p.h. Therefore, let us take an 80-m.p.h. car for example. If we project the horsepower curve to the right of *A* in Fig. 1, we find that the power drops so rapidly that the curve intersects $K = 0.0011$ at *a*, showing a gain of only 4 m.p.h. in top speed, or scarcely 5 per cent. But still the wind resistance was cut in half. This shows that we must consider other factors besides reducing wind resistance if we expect to improve the top speed. Above 50 m.p.h., acceleration is considerably improved; although the top speed is not. However, forced induction greatly changes this factor.

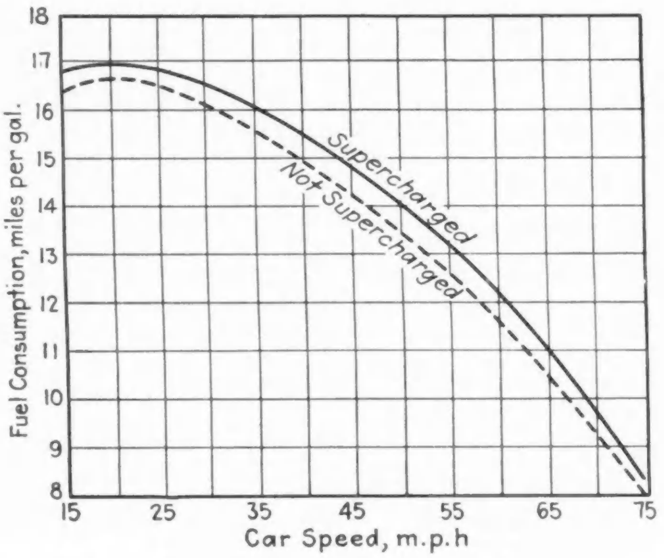


Fig. 3—Relative Fuel Economies of a Standard Non-Supercharged Car as Compared with a Duplicate, but Supercharged Car

The solid-line curve is for a Model-69 sedan having a standard supercharged engine and a 1½ Stromberg carburetor. The dash-line curve is for a Model-67 sedan having a standard non-supercharged engine and a 1½ Stromberg updraft carburetor.

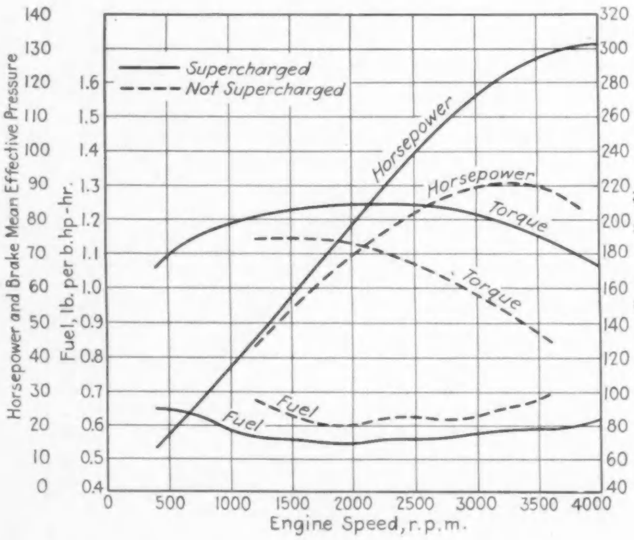


Fig. 2—Effect of a Supercharger on Engine Power and Efficiency

The curves are for a 3¼ x 4-in. Graham eight-cylinder engine when supercharged and when not supercharged. The solid-line curves are for a 5.76:1 supercharger ratio and a 6.72:1 compression ratio. The dash-line curves are for a 3¼ x 4-in. engine—not supercharged—having a 6.72:1 compression ratio. These curves are plotted from laboratory observations not corrected for barometric pressure or temperature.

Suppose that with this $K = 0.0011$ car we raise the engine speed 20 per cent and sustain the peak horsepower by slight supercharging, say 1.5 lb. This is shown at $b\text{-}A_1$ in Fig. 1. This change would increase car top-speed 25 per cent and improve the acceleration 29 per cent at 50 m.p.h., 47 per cent at 60 m.p.h., 223 per cent at 70 m.p.h., and put the top speed close to 100 m.p.h. over that of an unsupercharged and unstreamlined car. Compare this performance with a big powerful car with ordinary wind resistance. The curve *C* represents this type of car. The peak power required for this car to make 100 m.p.h. is 6.17 hp. per sq. ft., compared with 3.7 hp. per sq. ft. for the slightly supercharged and streamlined car, A_1. Thus, an engine 64 per cent in size can be used due to halving the wind resistance and forced induction.

For comparative purposes suppose that we supercharge the *A* engine to a manifold pressure of 4 lb. per sq. in. The results are shown by the curve, *E*. This engine would increase the top speed of a standard car 12.5 per cent; but, if the wind resistance were cut in half, it would improve the top speed 29 per cent. From this it will be evident that not a large amount of supercharging is necessary to obtain the full advantages of a 50-per cent improvement in wind resistance. On the other hand, just streamlining a standard car is likely to be very disappointing. The alternative of changing the gear ratio so as to keep the engine speed down would result in substandard acceleration.

Dual ratios accomplished by two-speed axles or overdrives will not accomplish the same results as forced induction because, while top speeds may be increased somewhat with these devices, they do so at the expense of acceleration at intermediate speeds. In fact, the manufacturers using these devices do not claim great top speeds as their main advantage, but rather the reduction of engine speed and the consequent more pleasant and economical operation. Top car-speeds with these devices have usually increased speed only 2 to 4 m.p.h. over that of standard equipment. However, slow engine-speeds through the use of overdrives and the like are desirable if sufficient excess horsepower can be provided to give satisfactory performance at intermediate speeds.

Consider the effect of forced induction on this picture. With a supercharged car, engine speeds can be reduced by changing the overall-drive ratio without lowering the standard of acceleration at the intermediate speeds. Therefore, it becomes obvious that forced induction in connection with overdrives and streamlining produces the only complete picture.

From the economy standpoint this will also be the most ideal set-up. The saving in fuel by reducing the wind resistance of the vehicle and reducing engine speeds through overdrives is obvious. This saving of fuel is considerably increased by forced induction.

Fig. 2 shows a comparison between the horsepower, torque, and fuel-consumption curves of the $3\frac{1}{4}$ x 4-in. eight-cylinder Graham engine when supercharged and when not supercharged, the latter being a standard engine. The same

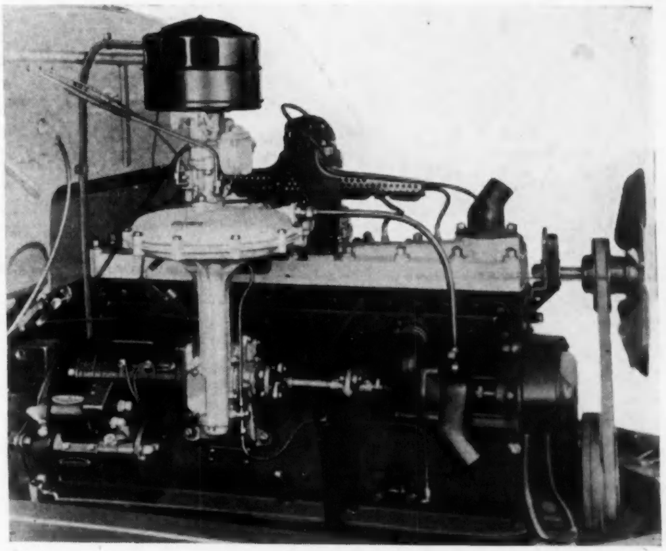


Fig. 4—Centrifugal-Type Blower Installed on a Graham Engine

compression ratio of 6.72:1 was used in both engines. It is noticeable that the full-load economy is better with the supercharged engine throughout the entire speed range.

Fig. 3 indicates the relative economies of a standard non-supercharged car as compared with a duplicate, but supercharged, car. It is interesting to note the consistent improve-

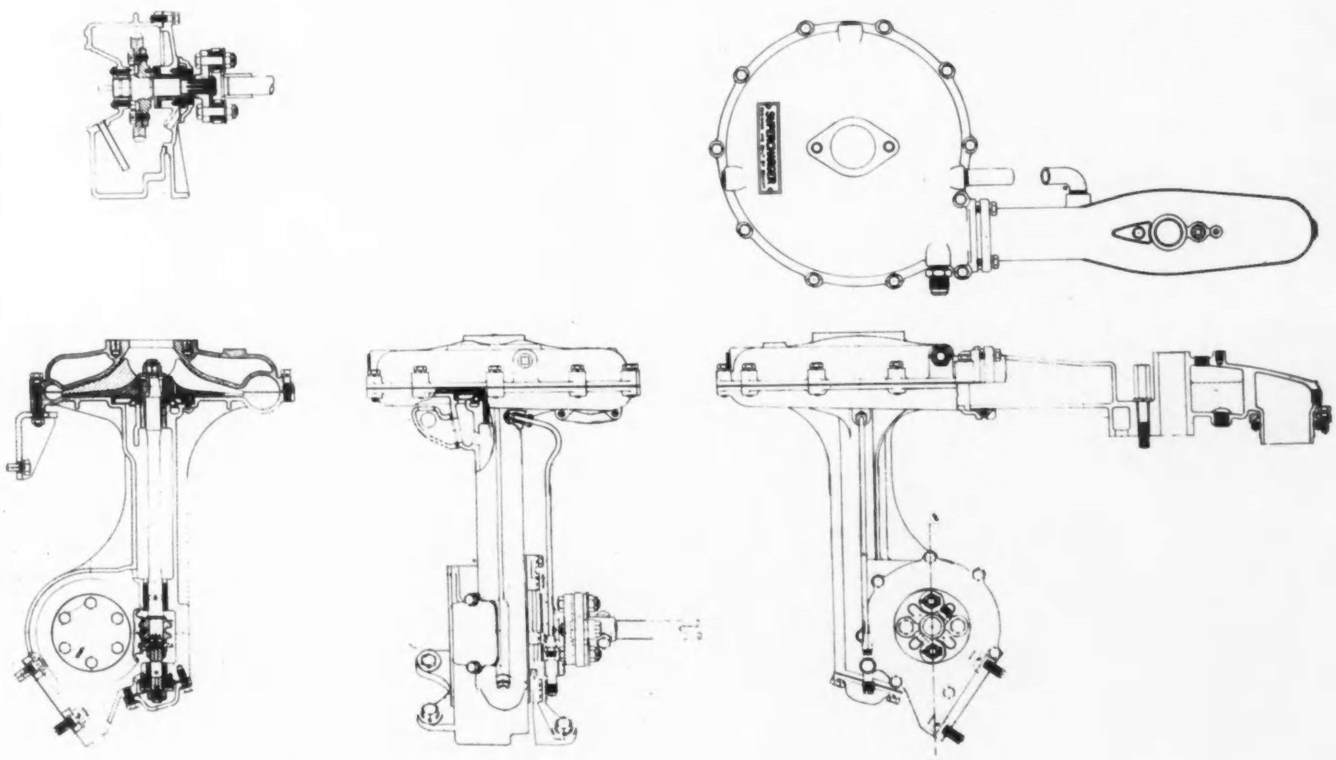


Fig. 5—Blower Arrangement for the Installation Shown in Fig. 4

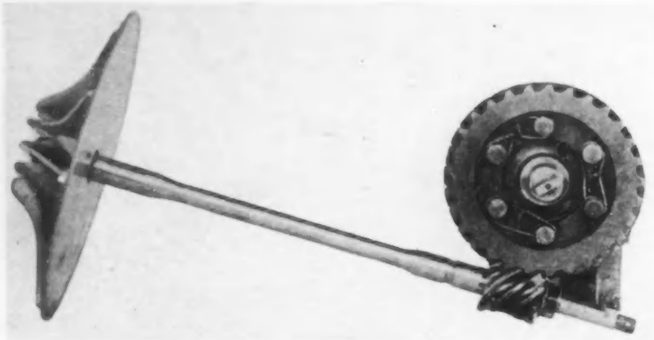


Fig. 6—Worm-Gear Drive, Impeller Shaft and Impeller Assembly Used by Graham

ment over the complete speed range. Subsequent tests made recently at 80 m.p.h. between these two cars showed an improvement of 2½ miles per gal. in favor of the car with forced induction.

The horsepower required to drive the blower on a positive-induction engine does not represent a net loss of indicated horsepower. A modern four-stroke gasoline engine has only approximately 50 per cent mechanical efficiency as a suction pump. A well-designed blower has about the same efficiency; therefore, for a given charge of gas delivered to the cylinder either by the engine as a suction pump or by the induction blower, about the same amount of work is done.

Tests performed under the direction of Floyd Kishline at the Graham Laboratories indicate an increase in the overall friction horsepower at 3000 r.p.m. of only about 50 per cent of the horsepower input to the blower. This shows that much of the power used by the blower is used to offset the pumping losses of the engine.

This comparison was made with the throttle wide open and, as the brake horsepower at this speed was increased 28 per cent, the weight of the charge delivered must also be larger. Further, as the specific fuel-consumption is less, the net mechanical loss chargeable to forced induction must be small, if any. The power consumed by the blower drops sharply when the throttle is closed; so, the small ratio of losses is substantially maintained. The power consumed by the blower alone on the Graham engine of 265 cu. in. at 24,000 r.p.m. is about 9 hp. The Graham engine-blower speed-ratio is 5.76:1. The impeller diameter is 7½ in.

Fig. 7—Drive Developed as a Step-Up Unit for Use with Centrifugal Blowers

An important point productive of economy is the effect of the mechanical agitation of the mixture in the rotor chamber. This results in even firing and smooth running over a wide range of mixture ratios, which is borne out by the facts that the tendency for backfiring is practically eliminated and very little choking is required either for an initial cold start or for warming up. It is further borne out by an almost immediate throttle response after starting.

The same general characteristics were present with the Packard engines used in Gar Wood's Miss America X,

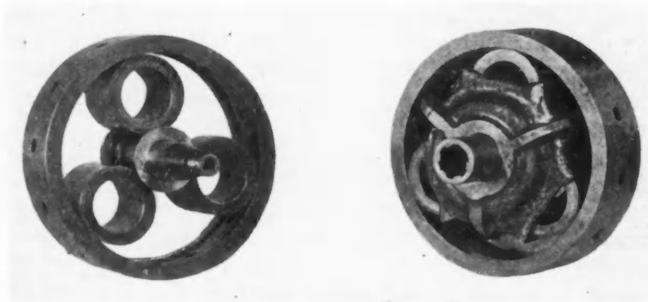


Fig. 8—Frictional Planetary Drive-Unit

The outer member or ring is held and the rollers are driven by a spider. The impeller is carried by the center member.

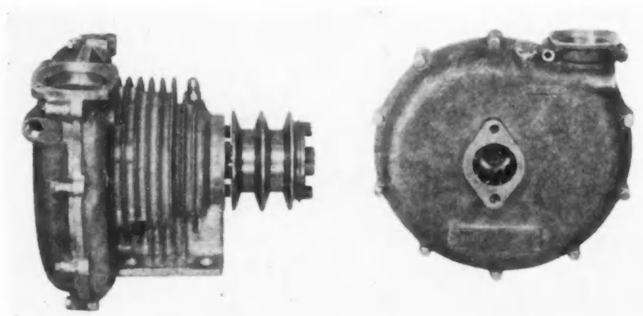


Fig. 9—Planetary Drive-Unit of Fig. 8 Built into a Unit which Is Designed To Be Driven by Multiple V-Belts

which were supercharged from 1100 to 1650 hp., where much smoother engine operation was obtained along with a considerable gain in economy. No difficulty was experienced with spark plugs or valves.

Knowledge of forced induction, or supercharging, with its attendant benefits, is not a matter of recent accomplishment. In reviewing a short history of the subject, Mercedes is probably the most noteworthy pioneer in this work. This company has built engines with forced induction for nearly 18 years and has, in its production, used the Roots-type blower exclusively.

Three general types of blowers are adaptable for use with internal-combustion engines of the vehicular sizes. Respectively, they are the Roots type, the vane type, and the centrifugal type.

The Roots type is best adapted where high manifold pressures are required. They are positive displacement units. They find an ideal adaptation as scavenging pumps on two-

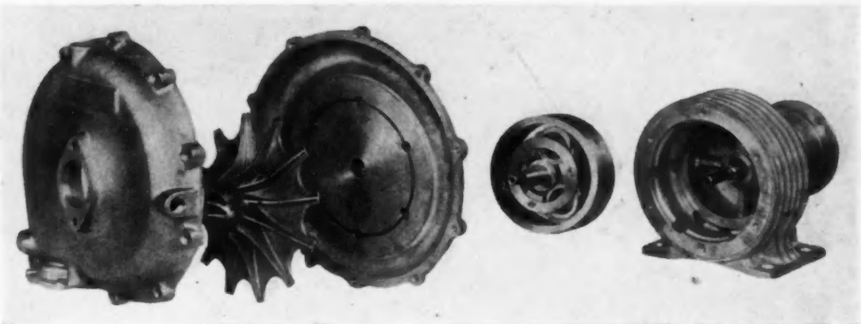


Fig. 10—Details of the Unit Shown in Fig. 9

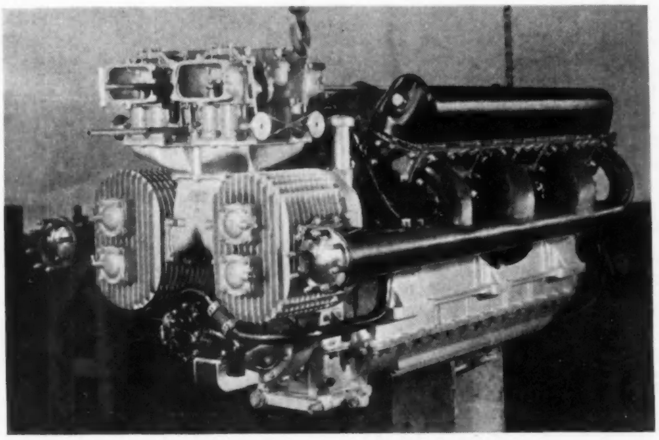


Fig. 11—Roots-Blower Installation on a Packard 2500-Cu. In. V-12 Aircraft-Engine

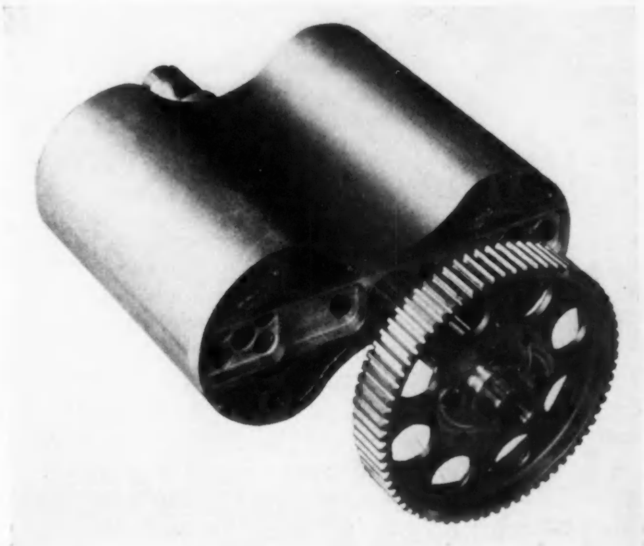
cycle Diesel and gasoline engines because of their good delivery characteristics at starting. On the average passenger-car installation, however, the noise that this type of unit makes presents a considerable problem; further, even in production quantities they are rather expensive to build.

Vane-type blowers are very efficient and small in both size and weight for a given displacement. This type has not been successful in automotive work, however, for several reasons. Lubrication is necessary for the vanes and vane guides. The difficulty of lubrication, in addition to the tendency to become gummy, has been a serious problem. Vane and vane-guide wear also has been prevalent.

The centrifugal type of blower has proved most attractive for passenger, truck and bus work, because of its simplified construction and low cost. The improvements of the last two years in torque, horsepower and economy, gained by use of higher compression ratios, particularly through aluminum-head developments, have reduced the requirements for maximum manifold pressures to $3\frac{1}{2}$ or 4 lb. per sq. in. necessary to obtain the superior vehicular ability shown previously in this paper. This particular type of blower also is ideally adapted for vehicular purposes because it is practically noiseless. A rotor designed for constant-velocity gas-flow is very silent and can hardly be heard on the average engine with the typical intake silencer installed on its inlet. In fact, the blower completely subdues the normal intake roar and the effective intake-silencer design is a much more simple problem since it is easier to deal with the high-frequency noises emitting from the blower than with the lower-frequency sounds emitting directly from the manifold.

There is no more occasion for failure of a well-designed rotor than in an engine flywheel, since the safety factors of these two units are about the same with a reasonable manifold pressure of 4 lb. per sq. in. maximum. Floating valve-gear definitely limits the maximum engine speed. This likewise places a limit on the maximum rotor stresses.

This type of blower has received much notoriety with regard to its reliability from adverse experience in racing engines. However, let it suffice to state briefly that these faults do not apply on a well-designed commercial-installation. The usual blower drive-ratio on race cars was between five and six times engine speed, and these engines frequently turned as high as 8000 r.p.m. to gain manifold pressures of 20 to 30 lb. per sq. in. gage. The driving arrangements were almost identical in all cases, so that all inherent faults



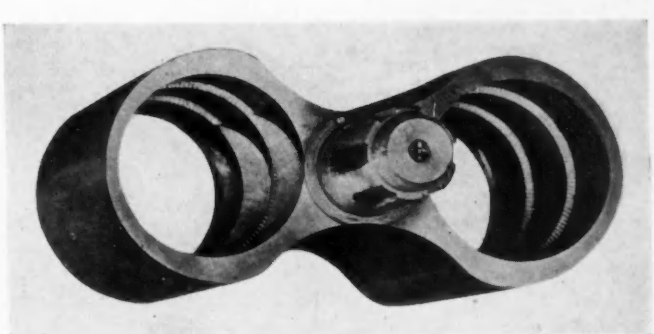


Fig. 12—(*Lower*) Roots-Blower Steel Wing Machined from a Solid Billet. (*Upper*) Construction Employed for Later Installations

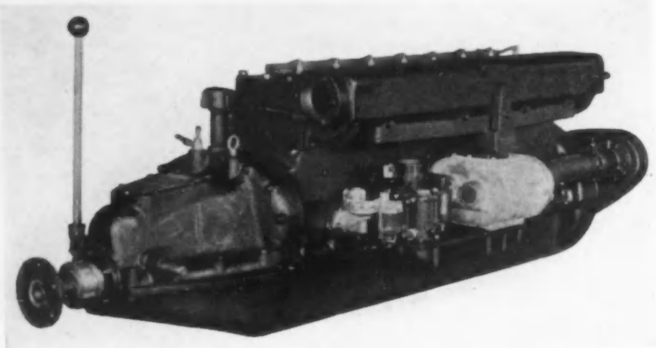


Fig. 13—Roots-Blower Installation on an Eight-in-Line Marine-Engine

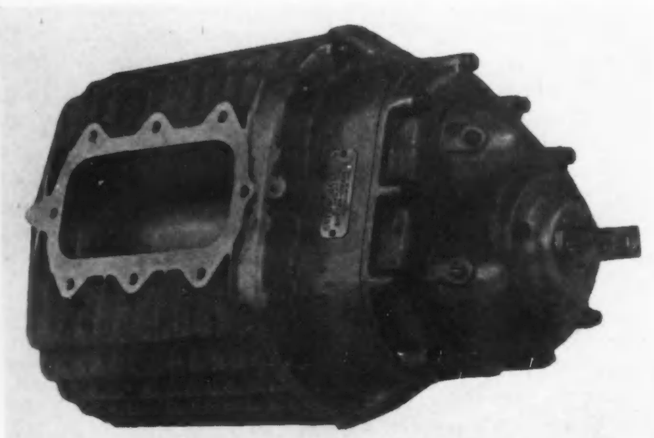


Fig. 14—Unit Designed To Mount in Front of the Engine and Be Driven by the Crankshaft

were general. Drive step-ups were accomplished through a train of spur gears, frequently poorly proportioned and fabricated, which involved a large summation of backlash. It was this backlash and the tremendous accelerations that were responsible for most gear-tooth and rotor failures. Even with the then typical drive arrangements, with their inherent faults, blower reliability was satisfactory at the time they were abandoned in racing.

The simplicity and cleanness of design arrangements possible with the centrifugal-type blower are evidenced by referring to the Graham installation, shown in Fig. 4. Drive for the blower is taken from the accessory driveshaft through a pair of worm gears. The blower discharges across the top of the engine to a downdraft manifold. The top half of the blower and the cross-over manifold are water jacketed. This water jacketing is the only heat applied to the manifold system. No hot spot is used. The arrangement is shown in Fig. 5.

The worm-gear drive, as well as the impeller shaft and the impeller assembly used by Graham, are shown in Fig. 6. Incidentally, plain bearings are used. In spite of the fact that the impeller reaches a speed as great as 24,000 r.p.m., these bearings have substantially the same rubbing velocity as crankshaft main bearings and their specific loading is much lower. Plain bearings used by Graham are made interchangeable and treated just the same as main bearings for clearances, lubrication and material. The rotor shaft is made of crankshaft material and has the same heat treatment.

Accelerative loads, thought by many to be unsurmountable because of the blower drive-ratio, are not serious. The maximum accelerative load is almost the same as the constant-speed load at maximum engine speed. Quite naturally, the rotor is designed for a low moment of inertia.

An interesting drive which we have developed as a step-up unit for use with centrifugal blowers is shown in Fig. 7. This particular unit was designed to mount in the same manner as the Graham unit and be driven from the accessory driveshaft. Only right-angle gearing is provided in the lower gearbox, the step-up being taken in the frictional planetary drive-unit immediately below the blower housing.

Fig. 8 shows the frictional planetary drive-unit which we have developed. On this unit the outer member or ring is held and the rollers are driven by a spider. The impeller is carried by the center member. This particular design has a number of advantages, some being no bearings on the high-speed shaft, silence, large step-ups easily obtainble, obvious production and cost advantages, and ease of adaptation.

Fig. 9 shows this drive built into a unit which is designed to be driven by multiple V-belts. Driving this unit by means of a V-belt offers great possibilities in the adaptation of blowers to existent engines. Fig. 10 shows details of this unit. All things considered, it must be admitted that either

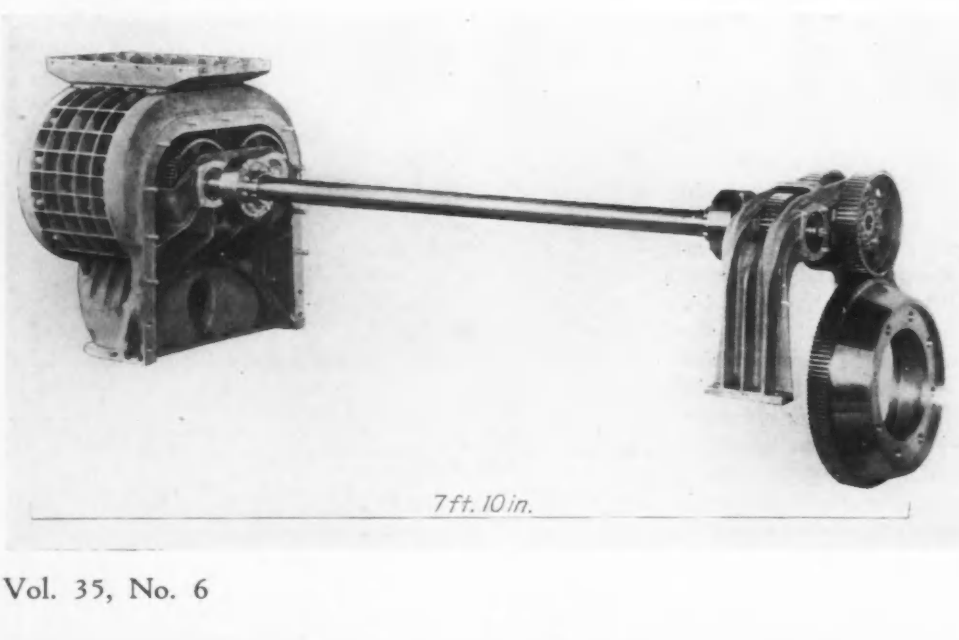


Fig. 15 — Large Supercharger and Drive Arrangement Built Recently for a 600-Hp. Two-Stroke Diesel-Engine

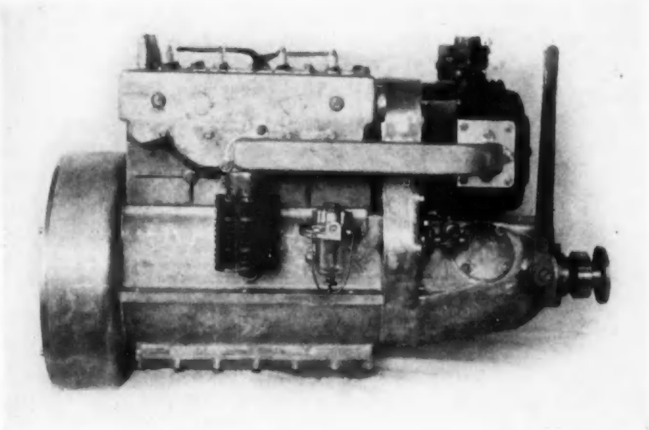


Fig. 16—Roots-Blower Installation on a Small Four-Cylinder Marine-Type Engine

the gear-drive method used by Graham, or the frictional planetary-drive method shown, involves but small complication as compared with the benefits obtained. We have never built vane-type-supercharger installations; however, we have made numerous Roots-blower installations, some being shown in Figs. 11 to 16.

Fig. 11 shows the Roots-blower installation on a Packard 2500-cu. in. V-12 aircraft-engine, four of which were used by Gar Wood in his Miss America X, with which he holds the world's aquatic speed-record of 125 m.p.h. Two blowers were used on each of these engines, one for each bank of six cylinders. Originally, we made the impellers or wings in our Roots blowers from a solid-steel billet.

In Fig. 12, the lower view shows a Roots-blower steel wing which was machined from a solid billet. On later installations, however, we employed the construction shown in the upper view, wherein high-strength-aluminum castings were used and driven by a steel driver inserted in the end of the machined aluminum casting.

Fig. 13 shows a rather clean Roots-blower installation on an eight-in-line marine-engine. The blower was bolted directly to the manifold and driven from the front gearcase. As mentioned, Roots blowers find an excellent application on two-stroke engines. Fig. 14 shows a unit which was designed to mount in front of the engine and be driven by the crankshaft, and carries step-up gearing within the gearcase.

Fig. 15 shows a large supercharger and drive arrangement which we recently built for a large two-stroke Diesel-engine. The engine for which this unit was built develops 600 hp. at 800 r.p.m. and is intended for submarine service. Fig. 16 shows a Roots-blower installation on a small four-cylinder marine-type engine. This is a noteworthy example of compactness.

The possibilities of forced induction, from both the standpoint of performance achieved and application of the blower unit, have been shown herein in a general way. I stated in a paper several years ago the logic of increasing engine performance by this means. This logic seems sound today, more so than ever, and it is believed that in a comparatively short time, automatic or atmospheric induction will have gone the way of automatic intake valves, and that mechanical induction will become the general practice.

I am indebted to Floyd Kishline and to Chester Ricker for their kind assistance in furnishing various data which have been presented in this paper.

Discussion

Supercharger Efficiency Considered a Major Item

—**Sanford A. Moss**

Thomson Research Laboratories, General Electric Co.

MR. SCHWITZER has long been associated with the design of Roots blowers for supercharging internal-combustion engines; so, the interest in centrifugal blowers shown by his paper is very significant. He gives as some of the reasons for preference for centrifugal blowers the elimination of the well-known noise which has always accompanied Roots superchargers, simplified construction and low cost.

Another comparison which has been made between centrifugal and Roots blowers is of the pressure rise produced, with the statement that Roots blowers gave full pressure at low speeds, where centrifugal blowers did not give such high pressures at low speeds. It was therefore alleged that Roots-blower superchargers gave better low-speed performance of the engine than did centrifugal superchargers. Mr. Schwitzer, having had experience with both types of blower, is in a position to make positive statements in this matter.

Another matter on which Mr. Schwitzer could make a definite contribution would be a statement giving actual results obtained on the road with the Graham superchargers in the hands of the driving public. How is the addition of superchargers working out in practice?

Mr. Schwitzer mentions limitation of manifold pressures to 3½ to 4 lb. per sq. in. above atmospheric pressure. What is the reason for this limitation? Ground-boosted aviation-engines are using much higher manifold pressures.

Mr. Schwitzer states that a well-designed blower has about 50 per cent efficiency as a pump. Exception must be taken to this statement. Commercial centrifugal compressors with design based on adequate research and mathematical theory have attained efficiencies as high as 83 per cent, and centrifgual superchargers for aviation engines based on the same theory, but with limitations due to conditions of installation, usually have an efficiency of about 70 per cent. The distinction is sometimes made between a centrifugal blower and a centrifugal compressor, the former merely "blowing" the air along without regard to its change of volume, and the latter taking proper account of the decrease of volume which accompanies pressures of the order of magnitude here discussed, so that they truly "compress" with proper efficiency, by use of the necessary passage areas and other design characteristics.

There is every reason for using the highest possible efficiency for a supercharger. Low efficiency means appreciable temperature-rise without pressure increase, which gives trouble with detonation and greatly decreases weight of charge. Actual applications of superchargers have been made where the decrease of charge due to temperature rise balances the increase due to pressure rise, so that the weight of charge

entering the cylinder was not increased. Furthermore, decreased efficiency means increased power for driving the supercharger, so that an appreciable amount of the gain in engine power due to supercharging is thus used up. Many years of experience with the supercharging of aviation engines shows that efficiency of the supercharger is a major item, and there is no reason to suppose that the situation will be any different with automobile engines. This predicates an adequate foundation of research data in the design and proportioning of the various parts.

Driving-Range Improvement By Supercharging Suggested

—David Gregg
Bendix Research Corp.

MR. SCHWITZER'S interesting paper is an indication of the recent progress in passenger-car design. A few years ago our efforts toward supercharging passenger-car engines were all directed at improving low-speed operation and acceleration. As a result, positive superchargers, either of the vane or Roots type, were used, because these gave the desired manifold pressures at low engine-speeds, and the pressure curve was largely independent of engine speed, a characteristic not inherent in the centrifugal compressor.

The increased horsepower of the passenger-car engine and, in particular, the use of synchromesh transmissions with silent seconds, have greatly increased the ease and rate of acceleration in the low speed-ranges. Several low-priced cars approach, in second gear, the maximum power that can be transmitted without excessive wheel slip and tire wear. The touring and high-speed driving-ranges are still open to improvement, and in these ranges the centrifugal supercharger fits very nicely.

In 1925, I designed a belt-driven centrifugal-supercharger for the Kissel car. Tests of this car on the road and on the Indianapolis track showed the same general characteristics as are secured with the present Graham supercharger; that is, improved acceleration and flexibility above 30 m.p.h. and a slightly higher top speed. This particular supercharger was mounted on the front cylinder block and the radiator fan was on the low-speed supercharger shaft-belt driven from the pulley on the crankshaft.

The possibilities of a multiple V-belt drive were further tried out on a vane-type supercharger on a Chrysler car, described in a paper presented to the Indianapolis Section of the Society in 1928. The belt drive was not a success, due to the limited space available for the pulleys, and was replaced by a positive drive. However, up to the limiting power at which the belts would slip, it provided a very quiet and flexible drive and acted as an effective flexible coupling between the engine and the supercharger.

Regarding Mr. Schwitzer's comments on racing-car superchargers, it is assumed that he is referring to the Miller car, as the Duesenberg supercharger was driven by a bevel gear and a planetary step-up. The fact that these various superchargers, operating at times well above 40,000 r.p.m. and using bearings frequently selected on account of their advertising value rather than their ability to operate at high speeds, with impellers that were seldom dynamically balanced, would last even the length of a race is really a remarkable demonstration of the inherent worth of this type of unit. It is also interesting to note that the supercharger compression-ratio obtained from impellers of 7½ to 9-in. diameter was as high as has ever been obtained with one stage of centrifugal supercharging.

Conclusions on "Observations of Flame in an Engine"

By Charles F. Marvin, Jr.
National Bureau of Standards

(Following are summary and conclusions which inadvertently were omitted from the article, "Observations of Flame in an Engine," by Mr. Marvin which appeared on pages 391-398 of the November, 1934, issue of the S.A.E. JOURNAL.)

IT would appear that at least seven basic factors control flame velocities in the engine. Three of these:

(1) the composition of the unburned charge,

(2) the temperature of the unburned charge,

and (3) the degree of local turbulence

influence the linear rate at which the flame kindles the unburned charge. The other four:

(4) general swirl,

(5) gas vibrations and wave effects,

(6) piston movement,

and (7) expansion of gases in reaction zone

affect gas movements which carry the flame front with them, the seven factors operating more or less independently but simultaneously to determine the observed travel of the flame in space.

Little or no reliable quantitative information exists regarding the separate effects of these factors but their relative importance in determining flame travel doubtless changes with combustion chamber geometry and operating conditions.

Preflame reactions alter factors (1) and (2), the composition and temperature of the unburned charge to an unknown extent which probably varies considerably for different fuels and has a bearing on the occurrence of fuel knock. Since these reactions are associated with relatively high temperatures and extremely short heating periods it would appear that they can be produced and their effects studied with certainty only in an engine or high-speed compression machine.

Lack of knowledge regarding the depth to which reaction and heat liberation continue behind the flame front prevents accurate evaluation of the effect upon flame movement of expansion in the reaction zone, (7), and obscures the correlation between flame travel and pressure rise. Measurements of infrared radiation offer a promising means of attacking this problem.

Fundamentals in the Selection of Cutting Oils

By W. D. Huffman[1]
Chevrolet Gear and Axle Plant

CUTTING oils are coolants and lubricants. As lubricants, they lubricate the area between the tool and the chip, and are tool and power preservers. Aside from these functions, they are useful in washing away the accumulated chips, giving a bright and smooth finish and acting as rust preventives.

There are two general types of cutting oils, the so-termed soluble or emulsifiable oil and the straight cutting oil. The soluble oils mix or emulsify in all proportions in water; they are primary coolants but also have some lubricating action. There are two types of soluble oils, those which are principally or entirely of mineral-oil origin and those which contain an appreciable amount of saponifiable materials or soaps. The straight cutting oils offer a greater range of composition, and likewise a greater field for individual preference.

Mr. Huffman emphasizes the importance of laboratory investigation and control, and says that the laboratory should cooperate in the selection and inspection of cutting oils. Summarized, the fundamental characteristics governing the selection of cutting oils are, for the soluble cutting oils, ability to emulsify, a tendency to remain stable without separation, and a tendency to prevent corrosion and give satisfactory finish. For the non-emulsifiable cutting oils, the characteristics are the quantity and nature of the saponifiable material and the quantity of combined sulphur not in natural combination.

SINCE the first developments of high-speed transportation, the principal items entering into the building of automotive equipment have been the making or fabricating of metal parts and their assembly into satisfactory working units. During the last ten years these problems have been intensified and broadened in scope by the changes and advances made; first, in the quality of the material from which the parts of a complete unit are made and, second, by the necessity for devising a method by which these parts could be fabricated rapidly, cheaply and accurately. With the introduction of harder, tougher metals and the design and construction of automatic high-speed cutting and grinding machinery, the problem of providing suitable cutting oils has reached a point where exact and scientific knowledge of the nature, use and application of these cutting oils is an absolute necessity.

Aside from tool and machine design, which has attracted the best talent existing in the metallurgical and engineering professions, little is found in technical literature of really scientific value concerning ways of maintaining tool life, conserving power and machinery, and facilitating operations. Certainly, the selection and application of cutting oils is of great importance and the study of this subject should be well worthy of any time and effort required.

One frequently finds, even in large shops equipped in the most modern and up-to-date fashion, a condition of general ignorance as regards the proper use and purpose of cutting lubricants. Too often experience and shop tradition are the sole guides in the selection of a given cutting fluid. The subject is not difficult and it certainly seems of paramount importance that the knowledge and experience acquired should be correlated and some standard practice adopted. A great deal has been accomplished already along this line by two unbiased and competent observers, Geschelin and Boston; but it is time that their work should be supported and the proprietary tendencies removed from the subject. It is believed that there are too many nostrums in the cutting oil market.

[This paper was presented at the Production Meeting of the Society, Detroit, Oct. 10, 1934.]

[1]Collaborators in the preparation of the paper were C. B. Harding, of the Sun Oil Co., and W. H. Oldacre, of D. A. Stuart & Co., Ltd.

Purposes

There are popularly believed to be two general reasons for the use of cutting oils. They are coolants and lubricants. As lubricants, they lubricate the area between the tool and the chip, although one may wonder sometimes what is meant by lubrication under pressures of 100,000 lb. per sq. in., which some observers maintain is reached. Nevertheless we know that they are effective and are tool and power preservers. Aside from the above functions, they are useful in washing away the accumulated chips, giving a bright and smooth finish and acting as rust preventives. These latter purposes in all probability will be incidentally accomplished in the selection of a proper oil for one of the two general reasons.

Types of Cutting Oils

We have two general types of oils, the so-termed soluble or emulsifiable oil and the straight cutting oil. The soluble oils mix or emulsify in all proportions in water; they are primary coolants but also have some lubricating action. They generally, if properly made, are good corrosion preventives. Many times their emulsions are used solely as corrosion preventives. Because of their low cost, it would seem advisable that their use should be encouraged whenever possible, and it is quite certain that in many operations, where now more expensive oils are used, they could be advantageously substituted.

There are two types of soluble oils, those which are principally or entirely of mineral-oil origin and those which contain an appreciable amount of saponifiable materials or soaps. Either may make stable or effective emulsions, but the former apparently are more stable and resistant to unfavorable conditions.

Non-Emulsifying Cutting Oils

The straight cutting oils offer a greater range of composition and likewise a greater field for individual preference. At this point it is believed much knowledge is yet to be obtained. They usually contain one or all of the following constituents: mineral oil, saponifiable oil, and some non-metallic element, such as sulphur, which may be reasonably supposed to have some extreme-pressure lubricating-properties.

Mineral oils have never been considered all-purpose cutting oils, but many of us can remember when lard oil was the basis on which all cutting oils were evaluated and it was only the idea of the cost that was capable of diverting preference to other types. At present, we have treated mineral-oils without any saponifiable matter in them, taking the place of the former types and giving as good, if not better performance.

Under given conditions we know that mineral oil, with addition of saponifiable matter, will perform satisfactorily in a certain operation. We also know that a sulphurized mineral oil will perform the same operation with equal satisfaction. The problem involved is, just what is that characteristic inherent in each oil which gives the satisfactory performance, and in what amount does each of the selected ingredients supply that characteristic? Is it an oiliness that the saponifiable matter supplies, or is it extreme-pressure lubricating-properties that both the sulphur and saponifiable matter give?

Unquestionably, we will always have the problem of pressure and temperature with us in metal cutting. If the former, certainly that could be obtained in a proper selection of mineral oil; if the latter, surely less expensive oils can be supplied. Naturally, this is a plea for reasonably standard specifications for straight cutting fluids.

In an attempt to reach some degree of standardization, it is hardly possible that there would be prevented any investigation, research, or introduction of new and better cutting fluids. There would be no discouragement of progress, for a competitive market would always stand as a safeguard; but a great gain might be accomplished in the dissemination of knowledge about the constitution and the applications of cutting oils. I believe that, for every cutting operation, a given type of cutting fluid can be used and that for many other operations the same type will give equal satisfaction. It is possible with the present knowledge of the chemistry of cutting fluids and engineering in cutting operations to simplify greatly the field of application and uses of this material.

Frequently, in large shops, the selection of the cutting fluid is left to the decision of the person in charge of a certain operation. At times it is not at all impossible to find five or six different types from as many different sources, their selection being determined by such whimsical notions as odor, color, and apparent viscosity. Usually, chemical analysis and investigation reveal no justification for such varied selections. There may be a perfectly good oil purchased for general use, say, in tank storage, and at a price that would indicate its application wherever possible. The chances are that a certain mixture formed with this oil and light paraffin would do the job and save considerable expense. Assuredly, this is a condition that is hardly justifiable in the light of modern plant-management. It is evident that a classification of cutting oils, together with an organized outline of their applications, would be of inestimable value in simplifying plant operation. Oil engineers recognize this fact and the more reputable companies supplying the material would welcome the approach, I believe, of a more rational simplification of the market.

Laboratory Control

It might be of interest to note at this point the importance of laboratory investigation and control. Wherever possible it should be arranged that the laboratory should cooperate in the selection and inspection of cutting oils. An examination of incoming shipments will assure against lack of uniformity and substitution of products. Especially with soluble oils, which do not possess the stability that the other types do, is laboratory examination most valuable. An incipient tendency to separate, or a lack of satisfactory emulsibility, can easily be detected by the laboratory control, and a great deal of argument and expense avoided. Furthermore, the emulsion in use can be examined daily and knowledge of its condition obtaind in only a few minutes of any one's time. Many times good oils are received without favor and objectionable material given credit that it does not deserve when laboratory observation has been absent.

Too much cannot be said in favor of coordination between laboratory and shop. Might it not also be advisable that each shop have some technical person to whom the cutting-oil manufacturers can impart their information, experience and data? The lubricating engineer seldom finds the man with whom he contacts in the shop sufficiently schooled in petroleum technology to discuss the important phases of cutting-oil manufacture. Because of a lack of this particular experience, the latter is usully unable to evaluate the information he

receives and may find to his dismay that the former is not only an engineer but an equally good salesman.

Laboratory investigation usually parallels the stressed characteristics of the specification. The specifications are usually formed from certain conventional ideas as to what are necessary valuable qualities of oils. These qualities may or may not be determined in the successful use of the lubricant. Soluble oils sometimes are difficult to analyze and can be torn apart only by a most skillful analysis, and then it is questionable how important the analysis would be. Usually, all that one desires to know is its emulsibility, its rust-preventive properties and its tendency to separate. Then what would ordinarily be necessary would be to make a small amount of the emulsion with the oil and the water and examine it after 24 or 48 hr. The thing of greatest importance is that it shall emulsify and not separate.

With the non-emulsifiable cutting oils it is customary to evaluate the oil from the following: (*a*) specific gravity, (*b*) viscosity, (*c*) flash point, (*d*) fire point, (*e*) free acid, (*f*) saponifiable matter and (*g*) sulphur.

At one time the properties as determined by this outline were considered of great importance and, frequently, rejections of shipments resulted from even a slight variation from the specification set for a given material. Today, consumers of cutting fluids in general are taking a different attitude toward the significance of these properties. They may, as a group, be of value in making known to the laboratory man the history and nature of the material; but, unless laboratory tests are made in conjunction with production tests, some false conclusions may result.

The specific gravity, flash point, fire point and, probably, even viscosity are characteristics that are on debatable ground when it comes to making a proper evaluation of a cutting fluid.

A given specified specific gravity may so limit a supplier that he may be forced to use certain raw materials, but it certainly cannot in any way assure the buyer that he will receive any more useful product. The flash and fire points, within certain obvious limitations, may be placed in the same group with specific gravity. How often does the consumer specify a certain flash point and then have the production man blend with it a lighter oil, maybe even kerosene?

The importance of viscosity, as stated before, is debatable. Opinions given by about 20 different observers show about 50 per cent disagreement. It has been stated, I believe, by Mr. Boston that he believed that viscosity is of value only in retaining within the oil those ingredients which are necessary for efficient cutting operations. Certainly all of us have seen work, where a heavy oil was considered absolutely necessary, done, and done well, with oil of only half the viscosity formerly used.

But when we come to the consideration of the introduction of saponifiable material, or sulphurized material into a mineral oil, we apparently have arrived at a vital point. These additions unquestionably give characteristics to the oil that it does not naturally contain. It has been intimated before that it might be possible to eliminate fatty material, but at present it is fairly well established that it aids in cooling and lubrication. Sulphurized oils have been in use for so long and their effectiveness is so well known that it is unnecessary to discuss their merits. There is still some disagreement as to how much sulphur is needed, but that may be more or less determined by the amount of blending that is done in the shop or refinery.

Summarized, the fundamental characteristics governing the selection of cutting oils are as follows:

- (1) Soluble Cutting Oils
  - (1) Ability to emulsify
  - (2) Tendency to remain stable without separation
  - (3) Tendency to prevent corrosion and give satisfactory finish
- (2) Non-Emulsifiable Cutting Oils
  - (1) Quantity and nature of saponifiable material
  - (2) Quantity of combined sulphur not in natural combination

From this summary it would seem reasonably logical that, if the supplier and consumer could meet on common grounds, it might remove a great deal of misunderstanding and superstition that now exist in the manufacture, purchase and use of these materials.

Another question involved in the selection of cutting oils, and one which usually comes up after a given oil has been in use for some time, is that of infection. Rarely has one who has had anything to do with handling oils of any kind escaped this problem, and almost always there is involved a controversy. The companies marketing the oil have, as a whole, spent large sums of money and a great deal of time in the investigation of the apparent spread at times of infection among workers who necessarily must come into intimate contact with petroleum lubricants. Frequently, the consumer, who necessarily holds a certain responsibility as regards occupational diseases toward those under his employ, is at a loss as to what to do at the appearance of these skin eruptions. It is no more than natural that he should look to the nearest probable cause of his trouble. Of course, the oil is invariably given the blame, a controversy started, and often the vendor must find another place to sell his product.

Certainly, it is not to be assumed that the oil is never a carrier of bacteria, but we may be reasonably certain in stating that actual bona fide cases wherein spread of infection may be blamed to oil are extremely seldom in occurrence. Obviously, mineral oils are not media in which bacteria may satisfactorily propagate, and in the sulphurized or chlorided oils one would hardly suspect that they could exist at all. Likewise, in the soluble oils, a certain degree or rather excess of alkalinity should, we think, act in some respect as a disinfectant. It is not uncommon for one to receive a negative report from the bacteriologist, even when skin eruptions are prevalent among those working about machines. It might be suggested that sanitary working conditions and cleanliness may often solve a problem of this nature and save a great deal of investigation and worry. Furthermore, it is understood by all that certain persons, more than others, probably due to unusual skin formation or bodily function, are susceptible to petroleum or alkaline irritations. Frequent change of clothing and careful personal hygiene often result in very gratifying results.

Applications

For the application of all types of cutting oils for mass-production manufacturing, there remains a great deal of knowledge yet to be disseminated. Often there is not the proper discretionary judgment used in their selection and application. Of course, it is not easy to select a satisfactory oil for a given piece of work when all the difficulties to be encountered are not known. But with all this in view, the major problem is to find a type of oil that will supply the greatest number of needs or give the most successful operation on the greatest number of jobs. One approach to the solution of this problem may be found through the more general use of emulsions. There is a trend toward the

greater use of emulsions and it is believed that when their possibilities are understood their use may be enlarged.

Because of the increase in manufacturing schedules, the machine-tool manufacturers recently found themselves in the position of designing new equipment which would remove metal more rapidly, though many times the floor space was limited in an already over-congested shop. As an example, one of the interesting developments has been the addition of surface-broaching equipment either in horizontal or vertical plane. These machines, to a great extent, will replace the milling machines. It is interesting to note that when these machines first came into production there was little or no information tabulated as regards the most advisable cutting oil to be used, and so for a long period of time various types of non-emulsifying cutting oils were used on this equipment. Cutting oils composed of sulphur, fats and a combination of both, with mineral oil, have been used for a considerable time with reasonable results. However, there always has been and probably always will be excessive consumption of oil on high-production types of machines, the carry-off usually is great and this factor naturally leads to exorbitant expense.

The question to be considered here is whether a lubricant of extreme-pressure tendencies is desirable, or whether we find ourselves confronted with the condition of high temperatures. It is understood that considerable work is now being done on this problem and that emulsions have been found to be desirable on a great many jobs. It seems advisable that these data should be coordinated and tabulated so that they would be available to many consumers. An emulsion should be a desirable application on this type of equipment, in that it furnishes a principle of high refrigeration as well as some lubrication, and should there be high temperatures involved, the refrigeration should and will have a tendency to improve the life of the broach, which is a most important member of this machine. The metallurgist has contributed a great deal toward the solution of the problem of surface broaching. It has often happened that a cutting lubricant has been held in disfavor, when the problem was really one of machine ability. Frequently, in encountering machining difficulties, the solution has been found in the metal specification or heat treatment and not in the selection of the proper cutting oil or emulsion.

Another interesting operation of mass production is that of grinding. It is probably one of the finest processes, for in this operation we reduce metal to such tolerances as one-tenth of one-thousandth of an inch. In view of experiences of the past, considerable investigation should be made with regard to grinding lubricant or emulsion. We usually find in an industry a lot of traditional opinions as to what constitutes a good grinding lubricant. It is not unusual to find some person requesting that the piece should have a high luster, which may or may not be indicative of a good finish. Experience has probably proved that, with the average type of grinding machine, the tankage for holding the grinding lubricant is generally too small when consideration is given to the turbulences produced by the emulsion flowing to the abrasive member and back into the tank. Naturally, an emulsion should have some detergent or cleansing action, but the way to a finer finish and luster might be made easier by placing somewhere in a system facilities for the removal of metal particles and other abrasives. Some users of grinding machines and grinding lubricants have already found it advantageous to have a separate central and return system where the emulsion flows through the grinding machine by gravity and is taken to a point remote from the machine where it remains without excitement for a period of time, thus giving the grindings and abrasives an opportunity to precipitate while the emulsion is not in excitement.

Many other practical applications of cutting oils might be discussed; but the factors, such as speed, pressure, temperature and machinability, must also come under consideration, for these factors must necessarily vary from shop to shop and job to job. Of course, it is of economic importance to the automobile manufacturer that the most serviceable oil be secured for the least expense, and a change to a maximum use of emulsions will, as was stated before, be a step in this direction. This probably can be done, but the consumer must first be enlightened. It has been suggested that a committee—similar to committees now operating on fuels and lubricants—could be formed for the purpose of investigation of the cutting-oil problem. This committee, with meetings, if only once a year, might do a great deal toward the elimination of the confusion that now exists.

Air-Transport Operations

ANYONE who doubts that air transportation has long since graduated from the stage of a pioneer development to an established position in routine and essential forms of transportation has only to glance over the statistical records of commercial air-transportation in the United States for the last few years. In 1926, for instance, airplanes flew 2,000,000 miles in scheduled service and carried over 5000 passengers. In 1933, airplanes flew over 54,500,000 miles and carried over 568,000 passengers.

The expansion this record reflects is of particular significance. It represents not merely the familiarizing of the public with airplanes and the providing of increasingly extensive and frequent service, but the completion of a development period in airline operation during which efforts have been successfully directed toward placing scheduled air-service on a basis of dependability and efficiency.

This vital stage included the constant improvement of airplanes and powerplants, the lighting of the airways, the establishment of comprehensive weather-reporting services, development of two-way radio telephone-communication between planes and ground stations, invention and improvement of air-navigation instruments, installation of the radio range, systematizing methods of maintenance and repair of equipment, the assembling and training of personnel into efficient operating organizations, and so on.

—Excerpt from a paper entitled "Air-Transport Operations," by E. P. Lott, read at the Regional Transportation and Maintenance Meeting, Newark, N. J., Nov. 9, 1934.

Correction

On page 333 of the September issue of the Journal there was printed in a discussion by Dr. P. K. Frolich of the Graves-Mougey-Upham paper on Winter Oils, a figure showing "Consumption and cold starting characteristics of oils at various grades and viscosity indices." In the lower right hand ordinate of the chart which bears the legend "Oil Consumption—qt./1000 miles" the decimal points were omitted in the accompanying values so that the figures which read as printed 10 to 50 qt./1000 miles should read 1.0 to 5.0 qt./1000 miles; viscosity at 350 deg. fahr.

Vital Topics Feature Balanced Program Developed for Annual Meeting

THE broadest as well as the most highly technical interests of the Society's diversified membership will be met by the eventful program finally completed for the 1934 Annual Meeting scheduled at the Book-Cadillac Hotel, Detroit, Jan. 22-25.

The pressing, immediate question of what the N.R.A. means to the automotive manufacturer will be interpreted authoritatively by David Beecroft, Bendix Aviation Corp., who has been a special advisor to the deputy administrator in connection with the code of the automotive parts industry. The fundamental physical principles of television will be illustrated and explained by Dr. J. O. Perrine, American Telephone and Telegraph Co., at a student session. R. A. Bogan, Greyhound Management Corp., will talk of the abuses of highway courtesies and rules by motor vehicle operators.

Detailed technical expositions and analyses comprise a major part of the program, however, and will include presentation of the results of several timely researches which have been awaited eagerly by engineers. Discussion of acoustics and the airplane by Stephen J. Zand, Sperry Gyroscope Co., is one of the important papers scheduled which falls into this category. There will be such notable presentations as that by Prof. C. Fayette Taylor, Massachusetts Institute of Technology, on flame propagation; by A. M. Rothrock, National Advisory Committee for Aeronautics, on photographic studies of combustion in a high-speed combustion-ignition engine; by A. W. Bull, U. S. Tire Co. on tire noise; by E. G. Gunn, Walker Manufacturing Co., on muffler noise, and a number of others of equal significance and importance.

The basis for vigorous technical argument appears in a number of the papers scheduled, if titles are indicative. The topic of chassis lubrication as developed in separate papers by H. E. Hill, Studebaker Corp., and by A. J. Blackwood and A. C. Spencer, Jr., Standard Oil Development Co.; the topic of multi-range transmissions, treated by C. D. Peterson, Spicer Manufacturing Corp.; that of sound insulating and absorbing materials, by T. M. Prudden, Pacific Mills; and several of the subjects scheduled for presentation at an engine symposium session are typical of many others which bid fair to provoke vital and timely discussion.

A brief glance at the detailed program shown in the preceding insert, in fact, reveals a combination of topics and authors which assures uniformly significant and momentous sessions throughout the four-day meeting.

With final arrangements nearing completion for the engineering display which is to be held in space adjacent to the meeting rooms, this feature of the gathering seems certain to exceed in engineering interest even the highly successful exhibition staged in connection with the International Automotive Engineering Congress in Chicago last fall. The partial list of exhibitors shown here indicates the broad range of technical products which will be covered.

Partial List of Engineering Display Exhibitors

Aluminum Co. of America
American Cable Co.
American Chemical Paint Co.
Bunting Brass & Bronze Co.
Campbell, Wyant and Cannon Foundry Co.
Cleveland Graphite Bronze Co.
Continental-Diamond Fibre Co.
Detroit Edison Co.
Henry L. Doherty & Co.
The Dole Valve Co.
Federal Mogul Corp.
The Globe Machine & Stamping Co.
Hercules Motors Corp.
The International Nickel Co., Inc.
Micromatic Hone Corp.
Monroe Auto Equipment Co.
The Perfect Circle Co.
Thomas Prosser & Son
R. C. A. Victor Co., Inc.
Rivett Lathe & Grinder Corp.
The Skinner Chuck Co.
Spicer Manufacturing Corp.
Stromberg-Carlson Telephone Mfg. Co.
Trico Products Corp.
Tubular Rivet & Stud Co.
United American Bosch Corp.
Victor Manufacturing & Gasket Co.
Waukesha Motor Co.
Wilcox-Rich Corp.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Nov. 10, 1933, and Dec. 10, 1933.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

CAMPBELL, DONALD W. (A) International Harvester Co., Tractor Engineering Department, Chicago; (mail) 114 North Parkside Avenue.

COOK, LEONARD (F M) chief engineer, British Tar Spirit, Ltd., Slough, Buckingham, England; (mail) 8 St. Judes Road, Englefield Green, Egham, Surrey, England.

DAVIES, GEORGE W. (A) sales representative, Sealed Power Corp., Muskegon, Mich.; (mail) 2-111 General Motors Building, Detroit.

GILLEARD, JACK THOMPSON NEIL (J) automotive engineer, A. G. Boyes & Co., Ltd., Chapel Hill, Huddersfield, England; (mail) 23 Fairfield Road, Almondbury.

HANLEY, WILLIAM V. (J) fuel section, research and development department, Standard Oil Co. of California, Richmond, Calif.

JUDD, MORTON F. (M) vice-president, Raybestos-Manhattan, Inc., Raybestos Division, Bridgeport, Conn.

LAGO, ANTHONY F., MAJOR (F M) managing director, Automobiles Talbot, 33 Quai du Gen. Gallieni, Suresnes, Paris, France.

MARSH, AUSTIN G. (M) draftsman, Weaver Mfg. Co., Springfield, Ill.; (mail) 222 West Abriendo, Pueblo, Colo.

WARNER, FRANK ALEXANDER (A) vice-president, Mack Trucks, 42nd and Woodland, Philadelphia.

Applications Received

The applications for membership received between Nov. 15, 1933, and Dec. 15, 1933, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ALLEN, ERNEST H., manager, Allen Battery Co., Portland, Oregon.

BEDELL, SELWYN LLOYD, foreman, Howell Motors, Trentham, New Zealand.

BLONDE, J. CARL, service department engineer, Bendix-Eclipse of Canada Ltd., Walkerville, Ont., Canada.

BURWELL, ARTHUR WARNER, vice-president and technical director, Alox Chemical Corp., Niagara Falls, N. Y.

CHAPMAN, PERCY H., general manager, Long Manufacturing Co., Ltd., E. Windsor, Ont., Canada.

CROWLEY, JOHN R., salesman, Linde Air Products Co., New York City.

DILLON, JOHN W., purchasing agent, International Harvester Co. of Canada Ltd., Toronto, Ont., Canada.

DRAPER, CHARLES STARK, research associate, Massachusetts Institute of Technology, Cambridge, Mass.

EVANS, PERCY C., sales and service, A. Schrader's Son Inc., Toronto, Ont., Canada.

FANNING, STEPHEN A., office supervisor Bendix-Eclipse of Canada Ltd., Walkerville, Ont., Canada.

FLETCHER, JAMES, experimental paint engineer, Hudson Motor Car Co., Detroit.

FREEMAN, EDWIN W., superintendent of operations, Cities Service Oil Co., Ltd., Toronto, Ont., Canada.

FUHRING, GUSTAVE, service manager Metropolitan Distributors, Inc., New York City.

GRAY, ALEXANDER, president and treasurer, Gray Forgings & Stampings, Ltd., Toronto, Ont, Canada.

HALFORD, ANDY, superintendent, L. L. Adcox Trade School, Portland, Oregon.

HANNUM, CHARLES MARTIN, assistant to manager, Canyon Placers Inc., Dedrick, Trinity County, Cal.

HAZARD, SCHUYLER, JR., sales engineer, Seaman Paper Co., Detroit, Mich.

HELLSTEN, CARL T., superintendent of auto service, Warner-Quinlan Co., New York City.

HILLEBRAND, PAUL W., chief chemist, J. A. Nagy Co., Detroit.

HOENICKE, EDWARD E., sales engineer, Eaton Erb Foundry Co., Detroit.

HORGAN, RALPH THOMAS, vice-president and treasurer, Kroger-Jonas, New York City.

IRWIN, THOMAS H., manager, T. Eaton Co., Toronto, Ont., Canada.

JONES, T. K., assistant general manager, Willys-Overland Ltd., Toronto, Ont., Canada.

KASPER, W. F., vice-president and chief engineer, Fairmont Railway Motors Inc., Fairmont, Minn.

LAMBRIX, MAURICE A., engineer, Gear Processing Inc., Cleveland.

LINDBERG, O. P., 70 Lady Musgrave Road, Kingston, Jamaica, British West Indies.

MACKIE, MAJOR J. C., inspector of mechanical transport, British Army, London, England.

MCGEORGE, ROBERT SAMUEL TAIT, superintendent, Standard Engineering Schools, Toronto, Ont., Canada.

MUTCH, KENNETH H., service manager, Wentworth & Irwin Inc., Portland, Oregon.

REDMOND, JOSEPH H., inspector, Ternstedt Mfg. Co., Detroit, Mich.

SANDERSON, JAMES R., vice-president, Petroleum Conversion Corp., New York City.

SELBY, LOGAN FRASER, department manager, Ontario Motor League, Toronto, Ont., Canada.

SIMPSON, JAMES I., vice-president and general manager, Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ont., Canada.

SMITH, ROBERT SIDNEY, front axle technician, Bendix Service Corp., Detroit.

WOLFE, ARTHUR D., general manager, Motor Valve Products Corp., Ravenna, Ohio.

Chronicle *and* Comment

By
Norman G. Shidle

THE first cold snap of the year had just hit Detroit.

"I couldn't get my car started this morning," an automotive engineer remarked to Vice-chairman H. C. Mougey of the S.A.E. standards committee lubricants division. The speaker had attended many lubricants committee meetings, had heard most of the discussions about the effect of viscosity on cold starting, yet he had S.A.E. 40 in his crankcase at the time he was unable to start.

His attention called to the 20-W and 10-W oils which the lubricants division is urging for winter use, he changed his oil and the car started nicely.

Through the trade press and the daily newspapers, through car manufacturers and through oil companies publicity has gone forth on the recommendations of the S.A.E. lubricants division. (See p. 38 of S.A.E. JOURNAL, November, 1933.) Individual engineers are helping the cause by impressing on general executives of their companies the importance of further wide dissemination of the recommendations.

As Mr. Mougey writes, "This specific incident illustrates the importance of doing everything in our power to get out publicity on the necessity of using oils of the proper viscosity for winter starting. Regardless of how many times this subject has been brought to the attention of car owners in the past, it has to be called to their attention again each winter."

LONG ago we ceased being surprised when some boy in his early 'teens started talking aviation with an intimacy and technical understanding that set our automobile-trained mind adrift in a maze of wonderment. Now it begins to look as though the younger generation were going to be made air-minded in systematic and wholesale manner.

A "Flying Kindergarten" has been started for children between the ages of 7 and 14. Classes will be held twice a month for six months. A course will be given on aeronautics and allied subjects such as airplanes, engines, theory of flight, reading airplane instruments, navigation and meteorology. It is all to be in simple language that the younger children easily can understand. The sponsor is the Casey Jones School of Aeronautics, Inc., in Newark. Twenty students are attending the class and, at present, no charge is made.

ABOUT the middle of November, Eugene L. Vidal, Director of Aeronautics, Department of Commerce, announced that his department was making a survey to determine the market for low-priced airplanes, stating his belief that the aircraft industry could produce a two-place, low-wing monoplane to sell for $700 provided there was some guarantee of a market for at least 10,000 such planes.

Response to his queries and his statement were widespread and immediate. Eight out of the first ten replies to his questionnaire were from persons who definitely said they would become purchasers. Some aircraft engineers disagree with Mr. Vidal about the feasibility of $700 planes at this time. Others applaud his ideas. No one in the industry is indifferent to them.

Full argument of the technical possibilities before an S.A.E. audience seems assured quickly. Mr. Vidal has accepted an invitation to present his ideas in more detail to a meeting of the Philadelphia Section, Jan. 17.

Message from President Dickinson

ABOUT a year ago President Scaife remarked that he and Herbert Hoover had picked a ——of a year to be president of anything. It was—and it has been this year also in some respects—but not so far as the S.A.E. is concerned.

Our Society in comparison with everything else in sight has been a conspicuous example of how to meet emergencies.

It is needless to ask why the year's work has been so successful. In any organization it is the active group of members who put heart and soul into the job that assures success. The S.A.E. during the past year has been favored with what seems to me a most exceptional corps of councilors, committee chairmen and committee members supported by a membership which has appreciated the difficulties of the present year and has given the Society, if possible, more hearty support than ever before.

The International Automotive Engineering Congress in Chicago was a conspicuous success as have been the other general and local meetings of the year, thanks to the committees which arranged them. I wish to commend particularly the committees of the local sections most of which I have been able to visit this year, for the splendid showing which the sections have made.

To the Council, the committees, general and sectional, to the members not in office and the Society's staff in New York and Detroit, I wish to extend my hearty appreciation together with New Year's Greetings and very best wishes for an even more happy, successful, and prosperous year, in 1934.

—H. C. Dickinson

What Members Are Doing

George A. Green, vice-president in charge of operations of the General Motors Truck Corp., has been made a member of the executive staff of three which directs the company's policy. *C. O. Ball* has been made chief engineer, his former title being division engineer in charge of coaches and all bodies. *W. D. Reese* becomes assistant chief engineer.

C. A. Ohl is director of sales for the Bendix-Westinghouse Automotive Air Brake Co., Pittsburgh. He was formerly district sales manager for the same company in the Pittsburgh area. His headquarters has been changed to Chicago.

Victor W. Kliesrath continues his interest in speedboat racing and has entered the International Twelve-Litre races to be held at Palm Beach and Miami Beach, Fla., next March.

Albert L. Schoff is connected with the Irving Worsted Co., Chester, Pa.

William L. Pratt is quality man on car wiring, oil and gasoline tubes, and radios, for the Dodge Bros. Corp., Detroit.

Robert B. Beauchamp is temporarily connected with the Wright Aeronautical Corp., Paterson, N. J., as planning engineer.

Fred J. Arnold is proprietor of the Klemme Auto Co., Klemme, Iowa.

Members Debate Service Policy

M. C. Horine, sales promotion manager, International Motor Co., defended the negative side of the question "That Self-Service of Fleets Assures Maximum Maintenance Efficiency" at a debate held in New York Dec. 7 under the auspices of the Automotive Service Association of New York, Inc. *F. K. Glynn,* American Tel. and Tel. Co., was chairman of the debate. *Austin Wolf,* consulting engineer, headed the judges, who refused to give a basic decision on the question in the absence of a workable definition of a "fleet." They pointed out, however, that the negative side of the argument had received the better presentation.

Charles B. Whittaker has rejoined General Motors South African, Ltd., as sales and technical representative, after an absence of 15 months, during which he was sales manager and technical adviser for Williams, Hunt and Co., Ltd., Benoni. Mr. Whittaker's headquarters will be at Johannesburg, Transvaal, South Africa.

Alfred H. Leja is designing engineer with Fairbanks, Morse & Co., Beloit, Wis.

Wide World

Orville Wright, who 30 years ago made the first airplane flight at Kitty Hawk, N. C., and Amelia Earhart Putnam, first woman to make the West-East solo flight across the Atlantic, are shown here as they both participated in the dedication of the Aviation Hall of the new Franklin Memorial Institute in Philadelphia. Mr. Wright became a member of the Society in 1916, and Miss Earhart an associate member in 1930.

Donald L. Bower, who was junior mechanical engineer with the Interstate Commerce Commission, has been named secretary of the Mississippi Valley Committee. The Committee is under the Public Works Administration of the Federal government, and its object is to correlate and coordinate the various projects which have been recommended from time to time for the development of the Mississippi Valley and its tributaries.

Boyd V. Evans, having completed a program of sales promotion work for the Electric Service Supplies Co., Philadelphia, has resigned as sales engineer of bus equipment for the company. Mr. Evans was formerly chief engineer of the Detroit Motorbus Co.

Boyd V. Evans

A. L. Beall

Almon L. Beall is test engineer with the Wright Aeronautical Corp., Paterson, N. J. For a period of about six years he was engineer in charge of fuel quality, export division, Vacuum Oil Co. and Socony-Vacuum Corp., New York.

Harold L. Ebbers, formerly sales engineer, Newton Die Casting Corp., New Haven, Conn., is now vice-president and treasurer of the Acme Metal Etching Co., Detroit.

Mason D. Hanes has resigned as special development engineer for the Buick Motor Co. to join the Lycoming Mfg. Co., Williamsport, Pa., as design engineer.

Robert Owen Montgomery has been promoted to captain, field artillery, U.S. Army, and is located with the field-artillery group, Federal Building, New York City.

Conrad A. Teichert has joined the aeronautical engineering department of the Lycoming Mfg. Co., Williamsport, Pa., as design engineer.

Ralph H. Rosenberg, consulting engineer, has joined the Detroit Automotive Development Co., which has under development a high-speed Diesel engine.

J. Henry Smith, automotive sales manager of the Ohio Carpet Co., Warren, Mass., has been elected a vice-president of the company.

Z. D. Granville is principal in a new partnership, Granville, Miller and De Lackner, which has been formed as consulting aeronautical engineers. The concern is located at 101 Park Ave., New York City. Mr. Granville was president and chief engineer of the Granville Aircraft Corp., Springfield, Mass.

Personal Opinions

(Being terse phrases spoken or written by Members or by their guests and ferreted from their context by an editor in an inquiring mood)

Experience so far seems to have indicated rather definitely that independent wheel suspension isn't something that can be added to a car—it requires a redesigning of the car around the suspension system.—*Athel F. Denham*

◇

To my mind a 2000-mile over-water, non-stop scheduled (airplane) run is a much easier and safer problem than an equal distance over land. . . I would prefer to make a trans-Atlantic flight, non-stop, in bad weather to a trans-continental trip with stops, in equally bad weather. . . . I believe that airplanes and engines have been developed to a point or can be built with what we now know, so that they would be almost 100 per cent certain of completing a trans-Atlantic flight. —*Clarence D. Chamberlin*

◇

Every indication points to a better understanding between the manufacturer and the operator, and I believe this change in attitude has been brought about by the splendid work that has been done by the Transportation Activity of the Society of Automotive Engineers.—*Fred. L. Faulkner*

◇

The possible use of electric-furnace brazing in controlled atmospheres, or merely copper brazing as it is commonly called, as a production tool has only been realized fully in the past few years. Even now, the realization is not widespread in industry, but it can be said that it is increasing rapidly as a clearer insight into the process itself points out its many possibilities in the fabrication of steel parts. —*G. E. Messer*

◇

The present system of automobile control is unnecessarily complex and difficult to learn. It is remarkable chiefly in the degree of refinement which has been attained in making a crude and indirect system practical in the hands of the public. It has never been a logical system because it was not worked out from a functional basis. Instead of providing a system for controlling the automobile, means were provided for handling the engine, clutch, and transmission.—*E. S. Hall*

Meetings Calendar

S.A.E. Annual Dinner

Monday, Jan. 8, 1934, Hotel Commodore, New York City.

S.A.E. Annual Meeting

Jan. 22-25, 1934, Book-Cadillac Hotel, Detroit, Mich. (See insert preceding page 9 in this issue for program.)

Baltimore—Jan. 4

Engineers Club of Baltimore; dinner 6:30 P.M.

Trouble Shooting in the Field — H. C. Mathis, automotive engineer, Gulf Refining Co.

Talk by Ira F. Thomas, coach of the Philadelphia "Athletics."

Canadian—Jan. 16

Royal York Hotel, Toronto; dinner 7:00 P.M.

Annual Motor Show Dinner.

Chicago—No meeting

Cleveland—No meeting

Dayton—Jan. 16

Engineers Club; meeting 8:00 P.M.

Meeting will be addressed by representatives of the Hudson Motor Car Co. and Pontiac Motor Co., who will talk on the 1934 models of these companies.

Detroit—Jan. 22 to 26

Hotel Book-Cadillac.

Cooperation in Annual Meeting of the Society; Jan. 22—Student Meeting.

Indiana—Jan.

Joint meeting with the American Society for Steel Treating at Columbus Club, Indianapolis.

Kansas City—Jan. 12

Ethyl Laboratories, North Kansas City; meeting 8:00 P.M.

Inspection trip through Ethyl Laboratories, demonstration and discussion of motor fuels.

Metropolitan—Jan. 23

Roger Smith Hotel, New York City; dinner 6:30 P.M.

Annual Marine Meeting during Motorboat Show.

Milwaukee—No meeting

New England—Jan. 9

Walker Memorial, Massachusetts Institute of Technology, Cambridge; dinner 6:30 P.M.

Oregon—Jan. 12

Lloyds' Golf Club House, Portland; dinner 6:30 P.M.

Tire Life—by a factory representative of a tire company.

Motor Transportation—H. W. Drake, Supt. of garage, Portland Gas & Coke Co.

Philadelphia—Jan. 17

Inquirer Building; dinner 6:30 P.M.

Plans to Stimulate Production of Low-Priced Airplanes—Eugene L. Vidal, Director, Aeronautical Branch, Department of Commerce.

Syracuse—Jan. 8

Onondaga Hotel.

Automotive Diesel Engines—Harte Cooke, Engineer, McIntosh & Seymour Corp.

Washington—Jan. 17

Sholl's, 1219 G St. N. W., Washington, D. C.; dinner 6:30 P.M.

Engineering Features of 1934 Automobiles —Clarence S. Bruce, Ass't Mechanical Engineer, U. S. Bureau of Standards.

Proposed Lighting Switch Recommendation

At a meeting Dec. 7 of the Lighting Division of the Standards Committee, a proposed recommended practice was outlined as a guide where foot-operated lighting switches are used with the new type of headlamp. Apparently the foot-operated switch has met with good acceptance where it has been tried out in place of a steering-column-mounted control switch, and with the existence of some sentiment that the foot-operated switch may come into wider use, the Division set up its proposals so that possible installation of the switch may proceed along uniform lines.

The proposed recommended practice appears in paragraphs 9c and 9d of the unconfirmed minutes of the Division. They read as follows:

(9c) The switching of automobile headlights from the clear road (driving beam) to the beam used for passing other cars (i.e., the meeting beam in the asymmetric type and the lower beam in the dual-beam type) should be by means of a foot-operated switch located in a position convenient to the driver's left foot. (9d) The switch should have no "dead" point and means should be provided for indicating to the driver that the clear road (driving) beam is on.

With respect to the last point the Division points out that a colored jewel light of very low candlepower mounted in the instrument panel is considered effective.

News of the Sections

- Blow-by May be Less
- Air and Springs Meet
- Less Power, More Speed
- A Bird Views Washington

Operating Economy Discussed From Engineering Viewpoint

● Northwest

HOW to drive motor vehicles over the highways at the least possible expense, was the broad subject handled by Prof. F. G. Baender, Mechanical Engineering head of Oregon State College, at the Dec. 8 meeting of the Northwest Section, held in Seattle. On several previous occasions Professor Baender has addressed the Section, but this marked his first appearance before this group in two years. His subject was "Economy Factors in Automotive Operation". Record attendance of the year was attracted for this meeting, 100 being present.

Economy factors present a gigantic problem, Mr. Baender explained, as he launched into the subject.

Many features are built into the car by the car builders, and these cannot be changed by the service man or owner, ordinarily. But there are other points over which service men and owners do exercise an influence.

Main groups discussed were (1) chassis design and maintenance; (2) engine designs; (3) body designs. "Type of gasoline best suited for a particular motor, proper carburetor adjustment, tire inflation, chassis or spring action are common matters over which there is control on your part," he stated.

"These you can influence remarkably, so don't worry over the things built into the car, that are largely beyond your control. You can and should build economy into the operation of automobiles."

Octane ratings were explained, with the conclusion that the lowest priced gasoline should be used that will not cause detonation. Third-structure gasoline is best for lower-compression engines, and contrary to accepted opinion, was better, cleaner and provided more mileage "if you can use it without developing detonation". This gas is free of "cracked" gasoline, being straight run. However there is greater economy in having higher compression when higher octane-rated gasoline is necessary for proper efficiency. Such engines decrease radiator and exhaust temperature, and as "heat is power", more heat goes to the rear axle, thus increasing power, which means greater economy. Charts also pictured carburetor adjustment for both power and economy output, with 15.2 to 1 (air-gas ratio) being found best average to obtain these two desirable goals. How testing exhaust gases for CO_2 and adjusting properly on this chemistry alone, effected a 27 per cent mileage increase on 24 average cars at the college was shown in a graph. These cars also averaged too rich a mixture by 27 per cent, and so Mr. Baender made the statement that all cars have carburetors adjusted to that too-rich-degree. Spark adjustment was also referred to as important. Proper tire pressure is another important factor in economy, he stated.

Streamlining was discussed, with the statement made that proper rear-end shaping is four times as important as the front end. Laying back the air stream with least possible turbulence or eddies, to cut down the "wind drag" at high speeds, especially, is of major help in this connection. However streamlining is most effective when driving into the wind or when air conditions are quiet, the effect being nullified by winds of varying direction, so that, in his opinion, too much stress can easily be given to streamlining, in which, however, he predicted important progress.

At speeds of 35 miles upward, economy of proper streamlines was evident, but not at slower speeds. "Drive slower" was his advice to the owner, as this factor is already determined by being built into the car. With wind at angles, streamlining is 90 per cent ineffectual, tests at the college proved. The streamline goal was of "whale" shape, he declared, for best results, according to both theory and practical testing.

Open forum discussions that followed the lecture, brought out that third structure gasoline, which is from 2 to 3 cents cheaper in price per gallon, in this territory, is best for engines up to 5.2 to 1 compression ratio.

The point of placing water in the overhead oiler, instead of oil, for greater economy of gas consumption, was advocated by the speaker, who had made practical use of this for the past two years. Recent results obtained at the University of Minnesota, as published in a book, covering this feature, confirmed experiments at the Oregon State College, he reported. Carbon in the cylinder head was caused by gasoline, and not the oil, was another emphatic statement of Professor Baender.

Service Problems On Ignition Told

● Oregon

A review and explanation of automatic mechanisms for distributors was undertaken by Frank Trowbridge at the Dec. 8 meeting of the Oregon Section, held in Portland. Charles Stuart spoke on vacuum ignition-control devices and Peter Muntz on some aspects of Diesel engineering.

Mr. Trowbridge pointed out that the electric current requirement is from 2 to 3 times more per motor vehicle now than it was 10 years ago; having risen from an average demand of 9 1/6 amp. to 35 amp.

Diesel engine service problems, such as crankcase dilution, misfiring, and pre-cooling of the compression charge were gone into by Mr. Muntz.

As a sidelight on the ignition discussion, Howard H. Morse recommended the installation of current regulators.

Attendance at the Section dinner was 48, and at the meeting, 61.

Consumer Research Divides Meeting With Copper Brazing

● Detroit

What the public wants in automobiles is a vital question when sales are concerned. J. C. Chick, general sales manager, Cadillac Motor Car Co., made this plain at the Dec. 4 meeting of the Detroit Section, when he spoke on "The Past and Present of the Automotive Industry" as part of a varied program which included a paper by G. E. Messer, General Electric Co., on "Electric-Furnace Brazing in Controlled Atmospheres" and a talk by Abner E. Larned, chairman, Detroit Regional Labor Board, on "N.R.A. in the Automobile Industry."

Mr. Chick told the 550 persons who attended that "from a survey of thousands of owners we have learned that people are thinking in terms of streamlining of bodies. However, they want streamlining that reflects beauty of line; under no circumstances do they want a body design that results in a gaudy, tricky car. It is the expressed opinion of many that such a car represents as bad taste as a man who struts around in a loud checkered suit with a bright red tie.

"I will not evaluate the features the public want in the order of their importance but rather enumerate to you what details, we have learned, are most desired.

"Motorists want door handles so placed on the car that they do not catch the sleeve.

They want bodies so well insulated as to be practically sound-proof.

"They want more comfortable, wider seats, easily adjusted front seats and round spokes in the driving wheel. They want less chromium on their cars, better paint jobs, spare tires concealed, and more package compartments."

Mr. Chick's observations were largely based on a consumer survey which the General Motors Corp. has been conducting for several months. Some of the other points he made with respect to what the public wants were:

"They want safety glass, greater visibility, more readable instrument panels, and more light in the car.

"These are only a few but they indicate that progress in designing bodies will come through a better understanding of the human factor.

"The provisions for the mental ease of a driver are probably the most important features built into a car. Relaxation comes not alone from sitting in an ideal seat but in a seat that is comfortable even when the occupants change from one posture to another. Seats should be so built that muscles and nerves get relaxation on a long drive."

In introducing his paper, Mr. Messer pointed out electric-furnace brazing in controlled atmospheres, or copper brazing, as it is more commonly called, is fundamentally a rather old process, but that its possible use as a production tool has only been realized within the last few years. After pointing out some of the disadvantages of the ordinary brazing method, he summarized the utility of the copper brazing method as follows: "In the copper brazing process, the entire assembly is uniformly heated, which assures a uniform and consistent flow of copper into all the joints. The reducing atmosphere not only insures that the steel surfaces will stay clean, but will reduce any oxides present upon entrance to the furnace. As a result, it becomes unnecessary to use fluxes, except with certain metals, and the absence of fluxes and any oxides insures a neat appearance in the completed assembly."

With the copper brazing process "copper iron alloy is formed on iron surfaces at the brazing temperature. It consists of approximately 3 per cent copper and 97 per cent iron. This alloy is only 'skin deep,' but it gives the copper a good bond with the iron, and provides a strength that cannot be obtained by other methods," he said.

Citing the tested strength of copper brazed joints, Mr. Messer stated that: "samples of high-carbon steel, brazed but not subsequently normalized, had an average tensile strength of about 70,000 lb. per sq. in. Each of these pieces failed in the joint.

"One of the leading automobile manufacturers has done considerable experimenting with this type of joint, brazing many different kinds of like and unlike steels. Most of these samples, when pulled, broke in the joint. In all cases, however, there was considerable elongation of the test sample and the ultimate strength approached quite closely the ultimate strength of the steels themselves."

The maximum tolerance for a gap in the joint to be brazed has been found to be about 0.003 in., Mr. Messer indicated.

Copper fillets remaining at the joint could be stripped in an electrolytic bath, if it were desired to remove them before subsequent processing of the assembly, he explained.

"Many parts now being machined, cast, forged, or fabricated by some other method," he concluded, "could be manufactured more easily, more economically, and better by taking advantage of the features offered by the electric furnace brazing process."

A photograph of one type of furnace for copper-brazing in production is shown herewith.

U. of D. Students Get Good Start

The University of Detroit student branch got off to a good start this year, according to P. Altman, director, department of Aeronautics of the institution, who heads the activity there. William B. Stout spoke to the students of "Trends in Transportation" at the first meeting of the season. About 125 students attended the meeting.

Traffic Problem Broadly Treated

• Washington

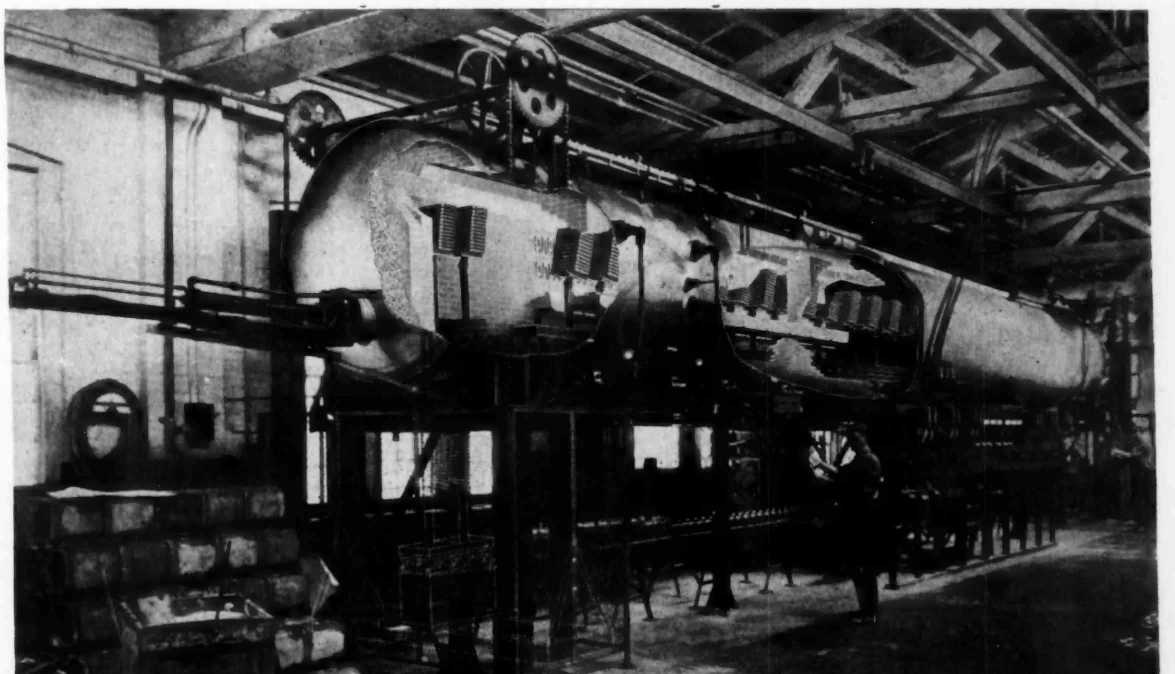
More careful tests for the selection of motor-vehicle drivers were predicted by Dr. F. A. Moss, head of the department of psychology, George Washington University, at the Dec. 6 meeting of the Washington Section. George E. Keneip spoke on "A Bird's-Eye View of Washington Traffic" and Messrs. Van Duzer and Eldridge, director and assistant director of the Washington Traffic Bureau, spoke on "Traffic Problems".

Guests at the meeting included Dr. H. C. Dickinson, president of the Society, C. B. Veal, standards manager, and E. D. Merrill, president and general manager, Washington Rapid Transit. All of them participated in the discussion.

Suczek Describes Engineering's Rise

•Baltimore

Seventy-two members and guests of the Baltimore Section gathered at the Engineers' Club of Baltimore, Dec. 7, to hear Robert Suczek, engineering department, Hudson Motor Car Co., give a paper on "Fundamental Progress in Automotive Engineering". Mr. Suczek utilized the development work of the Hudson organization in presenting his theme. The meeting was preceded by a dinner. There was no discussion of the paper.



Round semi-continuous pusher-type copper-brazing furnace with controlled atmosphere; 335 kw., 220 volts, 3 phases. Sections cut away to show position of articles in interior. This is a type of furnace mentioned by G. E. Messer in his paper at Detroit, Dec. 4.

Independent Springing May Change Bearing Applications

● **Buffalo**

Independent springing may change front-wheel bearing applications to a certain extent, it was pointed out by Ernest Wooler, chief engineer, Timken Roller Bearing Co., who spoke on "Anti-Friction Bearing Applications in Passenger Cars, Trucks, and Buses," at the Dec. 12 meeting of the Buffalo Section. Mr. Wooler indicated that because this design was still in the development stage, no definite prediction of the course it would take with respect to bearing applications could be made at present.

"The use of anti-friction bearings in the steering pivot has become quite common since the introduction of low-pressure tires," he said. "One construction . . . employs the tapered roller bearing at each end of the pivot pin, doing away entirely with the bronze bushings. A nicety of adjustment may be obtained through this mounting providing very easy and uniform steering. The front-wheel drive car revived interest in this type of mounting and independent spring suspension designers are again considering it."

Mr. Wooler described a great many specific vehicular applications of anti-friction bearings. He pointed out that such bearings are now used on virtually every point of motor vehicles where they can be used to advantage. Future applications, he believes, will depend on changes in design of such a nature that more bearings of different types can be applied.

A summary of Mr. Wooler's paper follows:

The opening remarks pointed out that the automotive industry is the largest user of anti-friction bearings, showing that they are used throughout the chassis, but not in engines except airplane engines.

Anti-friction bearings may be classed into two general types, the ball bearing and the roller bearing. The origin and general description of these two classes are given, and there are 50 illustrations shown on lantern slides connected with the paper, around which the whole paper is evolved.

The first illustration shows the variations of all types of different bearings, and proceeds with a detailed description of the tapered roller bearing.

The various points of the application of anti-friction bearings to a modern automobile is given, and the types of bearings used at each of these points, showing the predominance of tapered roller bearings throughout the modern car. The paper proceeds to describe all of these applications, beginning with the front wheels. Three or four illustrations of front-wheel bearing application on ball and roller bearings are shown and described. Also the flat thrust type of bearing and the tapered roller bearing used in the steering pivot application. Rear-wheel bearing mounting is next described, with four or five illustrations from the single bearing semi-floating construction on small cars to the full floating on large trucks and buses. Types of rear axle drive covering the spiral bevel, hypoid, and worm are covered, leading up to the pinion mounting and explaining in some detail a comparison of the overhung and straddle-mounted constructions. Various illustrations of overhung pinion mountings are given and described in detail, stressing the permanent type now in common use. The built-up and banjo axles are compared and their effect on bearing mounting analyzed. Straddle-mounted pinions on ball and tapered roller bearings are described, and the subject of lubrication for the pinion is very fully covered.

Rear axle drives used in trucks and buses, such as the dual reduction axle with bevel, spur, and herringbone gears, chain drive, and worm drives are fully illustrated and described in detail, especially as to their bearing applications. Differential mountings and their various bearing mountings and adjustments follow. There is a very complete analysis of transmissions and their bearing application, together with theoretical and practical points to be observed.

Universal joints are a new application point for anti-friction bearings, and an illustration and reason is given for such applications.

Three or four illustrations of fan and water pump assemblies are shown. The subject of steering gears is very fully covered, not only showing the anti-friction bearing equipment, but also explaining the advantages of their increased efficiency. Generator bearings, clutch pilot, and clutch throw-out bearings are also described and illustrated, as is also the application of anti-friction bearings to spring shackles. Miscellaneous applications of anti-friction bearings in heavy duty equipment, such as valve rocker arms, accessory shafts, power brakes, midships propeller shafts, compressor units, and brake and control shafts are briefly summarized and illustrated. Front-wheel drives and rear-engine drives are referred to, and in conclusion it is pointed out how the automobile engineer has taken advantage of the anti-friction bearing in the many points of application ahead of other mechanical industries.

K. C. Section Holds Smoker

● **Kansas City**

A get-together smoker was held by the Kansas City Section Dec. 8. C. A. Shepard, secretary, reports that 16 members and 7 prospective members of the Section were present.

Scientific Timing Held Sales Boon

● **New England**

Take the scientific instruments out of the laboratory, put them in the service station and it is a comparatively simple matter to demonstrate to the average motorist that the performance of almost any automobile can be immeasurably improved. Charles Mohnen, field representative, Joseph Weidenhoff, Inc., made this the theme of his discourse before a large audience, which turned out for the Dec. 12 meeting of the New England Section held at the Walker Memorial, Massachusetts Institute of Technology.

Ammeters, voltmeters, vacuum gauges, Wheatstone bridges, oscillographs, etc., tried and true friends of the scientist and engineer, can and should be used to educate and sell the layman. These, and other similar instruments, constituting old and conventional laboratory apparatus, find a new field of usefulness when dressed up and properly presented to the public. Properly designed testing panels not only make it possible to tune an engine accurately and scientifically, but their use is most impressive to the customer; their appearance creates a desire for better performance; and, in general, they are prestige and confidence builders.

Mr. Mohnen stressed the point that the action of the operator is an important element in the successful operation of such equipment, as a customer can easily be over-sold and he must not be brought to a state of mind where he expects miracles. The dinner attendance was 48, the total 87.

Valve-Spring Work Told by Pfeiffer

● **Pittsburgh**

"EXPERIMENTAL engineers are not satisfied with the present stage of (valve-spring) material development," according to a paper by Karl Pfeiffer, in charge of mechanical laboratory, Chrysler Corp., which was read at the Dec. 14 meeting of the Pittsburgh Section by L. M. Ball, of the Chrysler engineering department.

Pressure of work prevented Mr. Pfeiffer from attending the meeting and reading his paper on "Valve-Spring Experiences."

A second paper "Development of Industrial Air-Compressors" was read at the meeting by Allen C. Staley, research engineer, Chrysler Corp., the author.

Mr. Pfeiffer's paper traced the evolution of modern practice with respect to valve springs. "When top engine speed was about 2800 r.p.m.," he stated, "it was comparatively easy to obtain satisfactory springs. Increasing engine speeds, year by year, added complications, and today valve springs are considered as important as pistons, connecting rods, and crankshafts in the correct operation of the engine.

"Although there are numerous possibilities in selecting the diameter and length of the spring, it has been found through experience that, on the best designs, the ratio of the length, at valve-closed position, to the mean diameter is approximately 2 to 1. The best proportion of mean coil diameter is between 5½ and 7 times the wire diameter. If the ratio chosen is too small, there is danger of over-stressing the fibres on the inside of the spring, thereby causing premature failure.

"The spring design is not only determined by the load and stress requirements, but is also influenced by the surge characteristics of the spring. Spring surge, or spring vibration, multiplies the number of stress cycles through which the spring must work, thereby reducing its natural life. As a general rule springs with low rate vibrate with greater amplitude than springs of higher rates. Under basic conditions, therefore, the real stress on a low rate spring may be greater than the real stress of a high rate spring.

"The test engineer is forced to compromise between high stress range and surge. Since high stress is considered the lesser of the two evils, we find many valve springs intentionally designed to work above a point that would have been considered safe a few years ago."

In considering the materials suitable for valve springs, Mr. Pfeiffer said, in part: "About 10 years ago, when the average spring gear speed was around 1300 to 1400 r.p.m., any spring steel was satisfactory. The material most commonly used was a hard-drawn or patented wire. . .

"As the valve-gear speed rose above 1500 r.p.m., it was found that material became more important. The patented or hard-drawn spring wires were discarded for domestic oil-tempered carbon wire." For a number of reasons, Mr. Pfeiffer pointed out, this wire did not elim-

inate spring failures and was discarded. Chrome-vanadium wire was tried and spasmodic epidemics of spring failure were traced to mechanical defects in the wire.

"With the physical properties of the alloy wire for a standard," he continued, "a carbon wire was finally developed in Sweden, which was a good match for it. . . . Because of the structural uniformity of this wire only the deep etch test is made on it today."

In discussing methods for eliminating surge, the author stated: "Several well-known automobile engines are using today uniform-pitch, low rate springs in combination with various types of friction dampers. These springs have poor dynamic characteristics when operated alone, but in conjunction with friction dampers, are commercially satisfactory in respect to surge, especially when the installation is new. The disadvantages of spring dampers are complication, cost, and possibility of injury of the wire from wear."

"The final specifications of the dimensions of the spring are not arrived at by calculation, but by actual tests," Mr. Pfeiffer pointed out. "Most spring and automobile companies are in possession of different types of valve-gear set-ups on which spring samples can be installed and observed with the naked eye, or by means of stroboscopes. Instruments reducing fast speeds to slow motion have played an important part in the development of valve springs."

Teetor Points Possibility Of Greater Oil Economies

● Milwaukee

"WITH the information now available it is possible to produce engines that will show an oil economy as high as 2000 or 3000 miles per gal. and blow by as low as 5 cu. in. per min. per cubic inch of displacement, at driving speeds up to 75 m.p.h." This is the conclusion reached by Ralph R. Teetor, in charge of engineering department, Perfect Circle Co., Hagerstown, Ind., who gave further developments on the subject of "Conformity of Cylinders, Pistons, and Rings" at the Dec. 6 meeting of the Milwaukee Section. His paper was based on one presented by him at the International Automotive Engineering Congress in Chicago. About 70 members and guests of the Section heard the paper.

"Cylinder barrels do not remain cylindrical in the vicinity of their head portions under operating conditions," Mr. Teetor said.

"The thing that must be considered is the speeds at which engines are being operated. Piston speeds of 3000 ft. per min. are not uncommon. At such speeds rings may be forced to change but slightly the direction of their path, but the result will, in many cases, be a complete loss of contact between the face of the ring and the cylinder wall during some portion of the stroke.

"There is much evidence available which indicates that, when the best form of cylinder is fitted with a piston having the desired characteristics, the function of the piston rings is substantially simplified. The only duty which should be required of a piston ring is to form a filler or packing which will, under all conditions, seal the clearance between the piston and cylinder. The one purpose of the oil ring is to collect and return to the crankcase the surplus oil which, without such a ring, would be forced past the compression rings into the combustion chamber.

"The performance which may be secured from the working combination of any cylinders, pistons, and rings is entirely dependent upon the ability of the rings to remain in contact with the cylinder wall throughout the entire stroke. The slightest interruption of such contact breaks the compression seal and destroys the consistency of oil regulation.

"There is, in almost all high-speed engines, a critical speed at which the blow-by makes a radical change . . . engines having a break in the blow-by within the operating range . . . will not give satisfactory performance or long life.

"The destructive effect of excessive blow-by and high oil-consumption is so evident that no effort should be spared to take advantage of the available knowledge on this subject and make the changes that will result in better engine performance."

The accompanying photographs were shown in connection with Mr. Teetor's paper to illustrate cylinder distortion caused by a variety of conditions. The photographs were taken after the engines had been run sufficiently to show the variation of intensity of the pressure between the cylinders, pistons, and rings.

The photographs are in sequence from top to bottom of the column at right.

Photograph 1. Upper end of cylinder which has been distorted by clamping of the head. Necessary tension on stud *A* caused depression at spot *B*. The piston rings have passed over, without contact, this depressed portion of the cylinder, as well as that marked *C*, and contacted heavily at portions *D* and *D*.

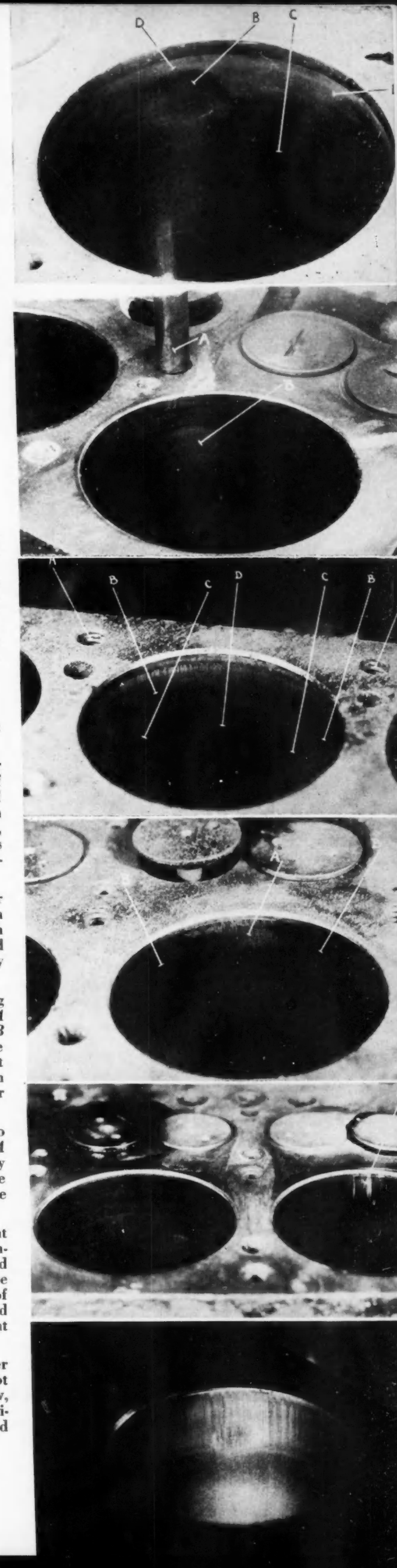
Photograph 2. Upper end of another cylinder showing, adjacent to stud *A*, a condition similar to that illustrated in photograph 1, except that the depressed area *B* is considerably longer vertically with the cylinder.

Photograph 3. Another cylinder showing distorted condition adjacent to studs *A* and *A*, plainly notable by black areas *B* and *B*. Crisscross hone marks are visible in areas *C* and *C*, which indicates that piston rings did not bear with pressure on these surfaces as contrasted with their much heavier pressure on surface *D*.

Photograph 4. Effect of distortion due to uneven expansion is shown here. Area *A* shows a portion of cylinder not properly contacted by the piston rings. In the dark areas, *B* and *B*, the piston rings have contacted.

Photograph 5. The cylinder to the right shows distortion due to uneven piston-ring expansion similar to that illustrated in photograph 4. In the cylinder on the left, three parallel lines mark end of travel of each of three piston rings and are evidence of considerable wear at these points.

Photograph 6. Opposite side of cylinder on left of photograph 5. The lines do not continue around the cylinder in this view, but it does plainly show evidence of serious distortion caused by the head stud anchor.



Transmission Problem Studied On Functional Basis by Hall

• Metropolitan

Editor's Note

The December meeting of the Metropolitan Section was scheduled for the 21st, several days after material could be included in the January issue of the JOURNAL. A paper by E. S. Hall on "Automobile Control and the Transmission Problem," which was to be part of the program, was preprinted, however, and the following excerpts were taken from the preprint. W. J. Davidson, General Motors' engineer, was also to speak at the meeting, but a copy of his presentation was not available as the JOURNAL was prepared for printing.

"The present system of automobile control is unnecessarily complex and difficult to learn. It has never been a logical system because it was not worked out from a functional basis. Instead of providing a system for controlling the automobile, means were provided for handling the engine, clutch, and transmission.

"From the functional standpoint, car acceleration should be controlled by a single agency in the same manner that deceleration is controlled by the brake pedal. The accelerator and brake should be arranged as twin pedals, preferably treadle style. Instead of using return springs which inevitably cause fatigue, the twin pedals may be interconnected so that the first result of the depression of either would be the return of the other to its 'off' position. These twin pedals should be big enough, conveniently adjustable, and comfortable so that the feet may enjoy riding on them constantly, the weight of one foot naturally balancing that of the other, yet with room for each foot to rest on the floor boards beside its pedal, if desired. . . .

"With acceleration and deceleration taken care of in this logical manner, the essentials of the new standard system of automobile control are the steering wheel, the fore and aft lever, and the pair of speed control pedals. In addition, of course, a control for the engine starter (preferably NOT mixed up with some other control), and the other electrical switches for ignition, horn, and lights, with some convenient means for operating the parking brake, would be required. It is assumed that automatic choke and spark advance, and thermostatic means for maintaining the mixture and the engine idling speed correctly adjusted for all driving conditions, can be provided in an acceptable and dependable manner. . . .

"The most obvious way to approach the transmission problem is to start with what we now have, and provide automatic means for controlling the clutch and gear shift. Possibly self-shifting gear boxes may be used for a few years, but it is hard to sustain any enthusiasm for them. They don't do enough. They make no fundamental attack on the transmission problem. The dissatisfaction with the present solution goes deeper than can be reached by any such superficial treatment as removing the shift lever. It is rooted in the fixed-ratio nature of the gear box. . . .

"For use with the present type of internal combustion automobile engine, the right solution of the transmission problem lies with some form of transmission by means of which one shaft may drive another at any ratio continuously variable under load between desired limits, a decrease in the speed of one shaft being accompanied by a corresponding increase in its torque relative to the other shaft. In other words, the right solution must be a practical, efficient, quiet, and inexpensive continuously variable transmission, properly controlled. . . .

"In the following discussion, the term 'rev ratio' will be used:

$$\text{Rev Ratio} = \frac{\text{Engine rev./min.}}{\text{Wheel rev./min.}}$$

The reciprocal of the rev ratio will be referred to as the 'drive ratio':

$$\text{Drive Ratio} = \frac{\text{Wheel rev./min.}}{\text{Engine rev./min.}}$$

"Control both for maximum economy and for maximum power should be so arranged that the engine will operate with maximum economy ordinarily but with maximum power always available for use when desired, without requiring any judgment or skill on the part of the driver to get either. Of course, if maximum acceleration and top speed are used considerably, the economy will not be what it would be if the driver were more discreet. In order to work out the right control system, answers to the following questions must be known:

"What rev ratios are desirable for maximum economy consistent with smooth performance?

"What rev ratios are desirable for maximum power applied at the wheels, for acceleration, hill-climbing, and top speed?

"What is the duty of the automatic control in maintaining the right rev ratios for maximum economy?

"What is the duty of the driver-operable control in modifying the automatic control when more power is wanted, and when starting with a cold engine?

"To illustrate a simple analytical method for arriving at the answers to these questions for any given engine and car, and at the same time, to acquire a fair idea of the improvement in acceleration and economy which can be attained, specific automobiles may be considered. It is not much use to discuss the present type of car, for by the time the new transmission can be generally available, today's car will be obsolete. However, the representative car of today with its familiar specifications and performance may serve as a fair basis for comparison.

"Four cases are of particular interest, involving two cars, as follows:

Car 33—The 1933 sedan model with an 80 hp. engine,

I with the usual gear box;

II with a continuously variable transmission.

Car 37—The streamlined car which we may expect by 1937, with a continuously variable transmission,

III with an 80 hp. engine;

IV with a 40 hp. engine.

"The following specifications are common to both cars, except as noted:

Overall Length: 174 in.; Width 68 in.; Height$_{33}$ 68 in.; Height$_{37}$ 64 in.

Wheelbase 114 in.; Tread 56 in.; Road Clearance 9 in.

Tires 6.00—17 in.; Rolling Radius of Wheel 14 in.

$$\frac{\text{Driving Wheel rev./min.}}{\text{Car mi./hr.}} = \frac{5280 \times 12}{60 \times 2\pi r''} = 12$$

Using a simple series of mathematical analyses, Mr. Hall arrives at a table of performance characteristics for Car 33 and Car 37. These are as follows:

Performance Comparison

Identification

I. Car 33—1933 Sedan, 80 hp., Gear Box.
II. Car 33—1933 Sedan, 80 hp., Continuously Variable Transmission.
III. Car 37—Streamlined Sedan, 80 hp., Continuously Variable Tran.
IV. Car 37—Streamlined Sedan, 40 hp., Continuously Variable Tran.

Top Speed
I. 1.00
II. 1.01
III. 1.37
IV. 1.05

Accelerative Ability, 0 to 65 mi./hr.
I. 1.00
II. 1.43
III. 1.84
IV. .97

Accelerative Ability, 0 to 40 mi./hr.
I. 1.00
II. 1.57
III. 1.69
IV. 1.12

Accelerative Ability, 40 to 80 mi./hr.
I. 1.00
II. 1.36
III. 2.50
IV. 1.00

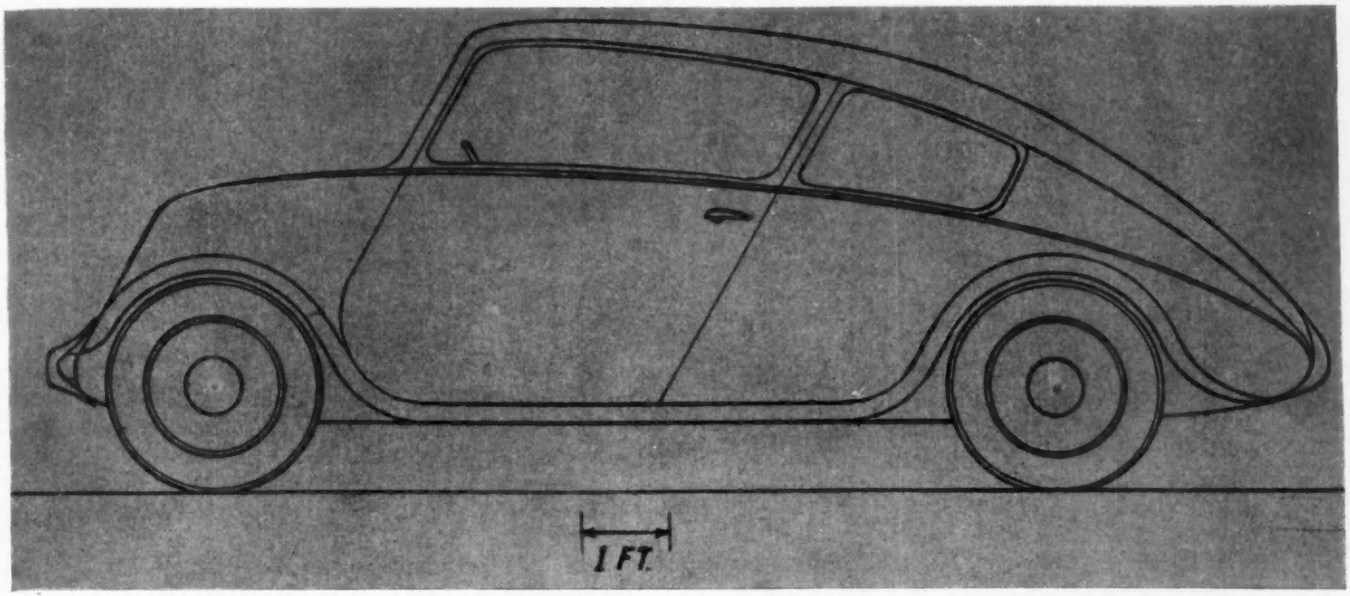
Gasoline Mileage, Average Cruising 30-70 mi./hr.
I. 1.00
II. 1.44
III. 2.25
IV. 2.76

Every conclusion in the paper is supported by calculations from standard formulas. Copies of Mr. Hall's paper giving the calculations in full of car performance are available on request from Society headquarters in New York. After establishing the superior performance of Car 37 of his design, Mr. Hall summarizes its advantages over current design as follows:

"The improvement due to streamlining is nil at low car speeds, but increases rapidly as the speed increases. The improvement due to the continuously variable transmission is greatest at low car speeds and extends in large measure well up the speed range, and is still effective to a small extent in increasing the top speed of the car. While a continuously variable transmission alone can improve acceleration and economy about 40 per cent each, its more important contribution is to permit the reduction in engine size by which performance can be improved still more.

"Demand will exist for super-highway hounds—cars capable of 120 mi./hr. with lower roofs, less frontal area, less visibility for the scenery, powered with engines of 80 to 90 hp., but it will be a specialized demand from those able or ignorant enough to pay the price. That price includes feeding and carrying around an engine twice as big as that necessary to do 90 mi./hr. Those who want full value for their money will rightly prefer the snappy acceleration and sufficient top speed of the light car of 40 to 50 hp., once they learn the fact that unnecessary weight, neck-breaking acceleration, and excessive top speed, pay no dividends and extract twice as much money from the pocket all the way from first cost to junk yard.

"Now that we know that gasoline mileage can be increased more than 150 per cent with



Car 37, shown above, was designed by E. S. Hall to show the possibilities of power economy when the control system is arranged on a functional basis. Mr. Hall estimates that Car 37 using an 80 hp. engine could do 112 miles per hr. With an engine of 36 hp. it would have the same top speed as a conventional 80 hp. car of the same general dimensions.

no sacrifice whatever in convenience or performance, who can say: 'No one is interested in fuel economy?' It may even be possible to sell the sales department on the idea that the public would buy cars capable of doing better than 40 mi./gal. with faster acceleration and top speed, and with a simpler and safer control system, even if new standards of appearance and beauty must be accepted at the same time. All these improvements in performance are clearly within reach by using an engine of half the size now used, in combination with real streamlining, light weight, and the continuously variable transmission properly controlled."

Truck Design Changes Reviewed by Bachman

• Philadelphia

About a hundred turned out to the Philadelphia Section meeting, December 13, to hear B. B. Bachman, vice-president and chief engineer, Autocar Co., describe recent developments in truck design and some of the underlying factors that brought them about.

Mr. Bachman's subject was "Building the Truck for the Job." His subject might have been "Building the truck for many jobs." Highly specialized hauling jobs permitted highly specialized body and chassis designs but the truck for general use dictated the present type with a separate chassis upon which the body is mounted.

The design of trucks has been affected by the physical characteristics of highways, their width, the density of traffic, by legal regulations and by the constant improvement of what might be called accessories, such as tires and steering gears.

Legal regulations have become more stringent, particularly as to permissible loadings on individual axles and of the vehicle as a whole. Such regulations are forcing a change in truck design in respect to load distribution on front and rear axles. In the past, general practice has been to divide the loading so that the front axle carried 25 per cent of the load, with 75 per cent on the rear axle. This distribution is really a "hangover" from solid-tire days when it was required to provide suitable traction and ease of steering with the somewhat crude steering gears then available.

The present almost-universal use of pneumatic tires with dual rear wheels and their greater traction has made desirable a redistribution of load, probably the best being 33 per cent on the front and 67 per cent on the rear. With the same size tires front and rear this distribution provides uniform loading on each tire, a desirable feature. Steering gears have been developed which make steering easy even under the heavier front-axle loads.

With the conventional type of truck the desired load distribution can be obtained by various shifts of the axles. The change preferred by Mr. Bachman is the shifting of both axles and the mounting of the cab over the engine, thus bringing the cab to the extreme front of the vehicle. This gives not only the desired weight distribution but also provides clearer vision, shorter overall length and, surprisingly, models built after this plan provide also superior riding qualities.

The discussion following the paper was extremely lively, covering almost every feature of truck design from power steering and larger engines to possible new conceptions of load suspension to provide a better ride for the merchandise. Even the much maligned transmission came in for its share of improvement although just what its final form would be not even the author could predict with certainty.

Basis of Operation For Fleets Defined

• So. California

The importance of keeping records of maintenance operations was stressed in a paper on "Maintenance Methods," read by H. E. Jordan, superintendent of equipment, Los Angeles Railway, at the Dec. 8 meeting of the Southern California Section.

J. W. Sinclair, supervisor of automotive equipment, Union Oil Co., and Fred C. Patton, assistant manager, Los Angeles Motor Coach Co., were the other speakers on the program.

If it were always realized that fleet operation is a means to an end instead of an end in itself, many complexities would be avoided, Mr. Sinclair declared. The basic element in fleet operation is the function of getting something from one place to another in the safest, most dependable, and most economical manner, he believes.

The gravity of the meeting was broken when Mr. Patton declared that it took more erasers than pencils to schedule a new bus route.

Ninety members and guests attended the meeting; sixty-three were present at the dinner.

Many Truck Makes Used on Desert Job

There was much interest in the description given by A. W. S. Herrington at the October Indiana Section meeting concerning construction of 1200-mile pipe line across the Iraq and Syrian deserts.

The impression may have been left that other members were not supplying equipment to this account, when, as a matter of fact, other truck manufacturers and engineers who are members of the Society have furnished equipment. These include White, F.W.D., International Harvester and G.M.C., as well as Thornycroft, Renault, Albion and Scammel.

Halladay Describes Proving Activities

• Dayton

Carl Halladay, of the General Motors Proving Ground, Milford, Mich., was the speaker at the Dec. 18 meeting of the Dayton Section. Mr. Halladay used motion pictures in describing in detail the everyday work of the proving grounds. He emphasized the fact that no research, in the narrower sense, was done at the Grounds, but that a great deal of the work of research was checked from the practical standpoint.

A film made by the H. H. Franklin Mfg. Co. to show in slow motion the action of springs, shock-absorbers, etc., was also shown at the meeting, which was attended by 72.

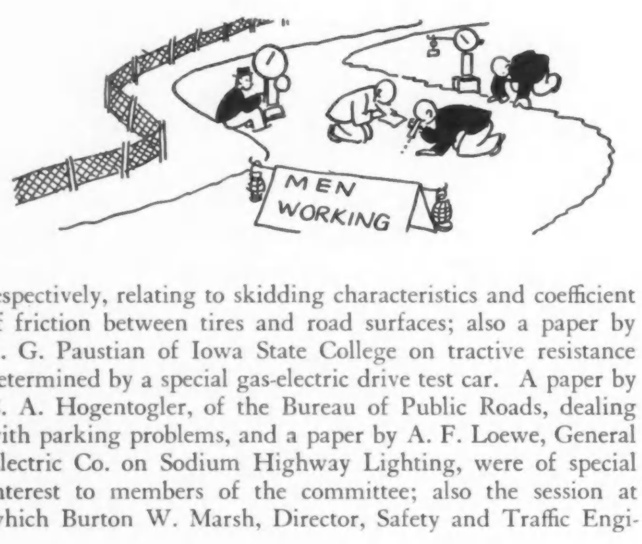
Behind the Scenes With

Non-Ferrous Metals

REVISIONS in several of the brass and bronze casting specifications and a new specification for nickel phosphor bronze castings are in the process of final approval as prepared under the supervision of Non-Ferrous Metals Division, W. H. Bassett, chairman. General information on copper, brass and bronze specifications including the common uses for various compositions, their physical properties and heat treating information, and data on various non-ferrous metal products and processes such as welding rod, special alloys and copper and brass plating are also included. Revisions and extensions of the aluminum specifications in the S.A.E. Handbook, together with informational notes on aluminum alloys and products, are being completed by P. V. Faragher, vice-chairman of the Division, and will be circulated soon.

Highway Research

PAPERS presented at three of the five technical sessions conducted as part of the program of the thirteenth annual meeting of the Highway Research Board, Division of Engineering and Industrial Research, of the National Research Council, recently held in Washington, were directly in line with the aims and purposes of the Society's Highways Research Subcommittee, such as: a report by Prof. W. E. Lay, Chairman of Project Committee on Tractive Resistance, supported by papers covering independent research at Iowa State College and Ohio State University by Prof. R. A. Moyer and Prof. Karl W. Stinson and Prof. Charles P. Roberts,



respectively, relating to skidding characteristics and coefficient of friction between tires and road surfaces; also a paper by R. G. Paustian of Iowa State College on tractive resistance determined by a special gas-electric drive test car. A paper by C. A. Hogentogler, of the Bureau of Public Roads, dealing with parking problems, and a paper by A. F. Loewe, General Electric Co. on Sodium Highway Lighting, were of special interest to members of the committee; also the session at which Burton W. Marsh, Director, Safety and Traffic Engineering, American Automobile Association, presided, including a report by W. A. Van Duzer, Chairman of the Committee on Highway Traffic, and Director of Vehicles and Traffic, District of Columbia, supported by seven independent papers, those of special note being: a paper by Dr. H. C. Dickinson, Chief of the Division of Heat and Power, Bureau of Standards, and president of the Society, on Rules of the Road in Theory and Practice; a paper by Dr. Walter R. Miles, Yale Institute of Human Relations, Yale University, Alcohol and Motor Vehicle Drivers; and a paper by W. A. Van Duzer on Motor Vehicle Accidents as Reflected by Psychological Tests and Time Reaction Meter, a paper based on results obtained with instruments developed by the Society's Riding Comfort Research Subcommittee.

A.S.T.M.—C.F.R. Tests

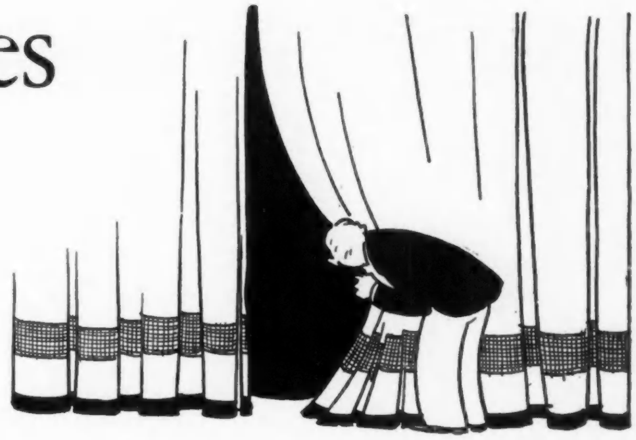
THE tests in the general check on the results being obtained by the C.F.R. Motor Method, (A.S.T.M. Tentative Method of Test for Knock Characteristics of Motor

Fuels, Designation: D 357-33 T) were conducted in 59 cooperating laboratories on Dec. 6. These tests are under the direction of the C.F.R. subcommittee on methods of measuring detonation, and a special group has been appointed, headed by H. F. Huf of the Atlantic Refining Co. to collect and analyze the results.

Tractor Program Initiated

THE first meeting of the new S.A.E. Tractor Committee was held in Chicago, Dec. 7, and an important program adopted. A subcommittee was appointed to gather available data on the many grades of tractor fuels in use and so far as possible similar information from abroad, with the purpose in mind of eventually developing a limited number of fuel and lubricant specifications and better engines for domestic use and export. Plans are also in the making for approval by the National Meetings Committee and Council for the first National Tractor Meeting to be held in several years. A subcommittee was also appointed to study the gen-

the Committees



eral subject of tractor traction, including track layers. The new Committee is concerned with both agricultural and industrial tractors and intends to work in cooperation with the Department of Agriculture, agricultural colleges, the American Society of Agricultural Engineers and other engineering and trade organizations concerned with the agricultural industry.

E. P. Lubricants Tests

DURING the first week in December the extreme-pressure lubricants research-subcommittee gave to individual companies the first reports of tests for load-carrying capacity on samples submitted.

These tests, authorized by the Research Committee at its last meeting, are being conducted on the subcommittee's test machine at the Bureau of Standards. The reports of load-carrying capacity are being submitted to owners through the secretary of the committee, at a cost to cover the expense of testing at the Bureau and allow a return to the extreme-pressure lubricants fund.

Automobile Lighting

PROBLEMS affecting the lighting equipment of automobiles continued at the fore, at the meeting of the lighting division of the Standards Committee in Detroit on Dec. 6 and 7, progress was made with several important projects. The dual-beam and asymmetric head-lighting specifications were put into better form for publication and with a view to submitting them for approval as the American Standard. A code for the proper usage and maintenance of automobile lighting equipment is nearing completion, probably also for eventual approval as American Standard.

A revision of the photometric specifications for direction signal lamps is being released for review before adoption and a progress report on revised specifications for reflex reflectors was discussed.

In connection with license plate illumination and in view of the possible trend towards setting license plates into recesses in the body panel, a study is in progress for the purpose of establishing one, or maybe two, standard size for license plates that could be adopted by all states of the Union. This project involves plate sizes, size and spacing of punchings for holding bolts and possibly color combinations and a study of the numerals.

A report on a study of the various types of automobile lamps, their location and their normal candlepower bulbs was discussed but in view of rapidly changing designs this report was tabled for the time being. The most important point in connection with marker lamps was the apparent necessity for a wider range of visibility at the sides of the car for identification purposes as cars approach road crossings or intersections.

In connection with the present standard for lamp bulbs, it is considered a little early to set up definite standards for the pre-focused type but it was decided to appoint a Subdivision to prepare a list of standard bulbs for use in aircraft lamps.

A new recommendation was approved for the arrangements for switching the headlights for asymmetric beams, preferably in a position for operation by the driver's left foot. A Subdivision was also appointed to review existing automotive lighting and lighting equipment standards in the Handbook for such revisions as may be necessary to modernize them.

Car Lubrication

H. C. MOUGEY, chairman of the Car Lubrication Committee, reports a broad and gratifying response to the efforts of the committee to educate the public to the use of the new winter oil, classified as S.A.E. 10-W and 20-W. A number of the committee members, representing the oil and automotive industries have been cooperating in the work.

Oil companies have been stressing the new classifications in their advertisements in daily newspapers and in house organs, Mr. Mougey says, and articles concerning them have appeared in a large list of worth-while business publications. Several companies have mentioned these new oils in their radio programs. Several automobile companies have had cards distributed to dealers, calling attention to the new winter-oil recommendations.

A sub-committee, headed by W. H. Graves, Packard Motor Car Co., was appointed to supervise publicity activity on the new classifications and to prepare additional material. The report of this sub-committee has been approved.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

A Simple Approach to the Wing Flutter Problem

By B. Lockspeiser. Published in *The Journal of The Royal Aeronautical Society*, September, 1933, p. 783. [A-1]

This paper constitutes an official report of the Air Ministry in two parts: I—Flutter of a Wing with Locked Aileron and II—Flutter of a Wing with Unlocked Aileron. Original research is described and numerous conclusions drawn.

Airscrew Design

By D. L. Hollis Williams. Published in *The Journal of the Royal Aeronautical Society*, June, 1933, p. 479. [A-1]

A brief review is given of the present position of airscrew design, dealing only with such parts as are of interest from the engineering point of view.

The author explains that due to the restricted length of the paper some cases which require specialized treatment have had to be omitted, but the outline of the problem, corresponding to the engineer's outlook after continued application of design methods to all classes of airscrews, is set down in the hope that it will present a useful picture of the workings of the process defined mathematically elsewhere.

Roues Sustentatatrices et Propulsives

C.-B. Strandgren. Published in *L'Aéronautique*, L'Aérotechnique section, September, 1933, p. 81. [A-1]

The wheel providing lift and propulsion here described is a rotating wing system consisting of wings parallel and equidistant from one another set about a central axis of rotation. Each wing can also turn about its own axis of rotation parallel to its length. The operation of such a wheel, which has been used for boats and is being tested by the Liore and Olivier company for flight purposes, is analyzed.

Du Boomerang à l'Autogire

By Jacques Mottez. Published in *L'Aéronautique*, September, 1933, p. 207. [A-1]

The gyroscopic and aerodynamic phenomena which govern the operation of the boomerang are analyzed and the extent to which similar effects are used or combatted in the autogiro is pointed out.

Stossartige Knickbeanspruchung Schlanker Stäbe im Elastischen Bereich

By Josef Taub. Published in *Luftfahrtforschung*, July 6, 1933, p. 65. [A-1]

This analysis represents the second part of a cooperative project of the aircraft research institutes of Germany and Holland. It deals with buckling stress under impact, within the elastic range, of rods of small cross section. The solution of the problem for certain mounting conditions is disclosed and the example of a rod mounted according to the third Euler case is worked out.

Stossartige Knickbeanspruchung Schlanker Stäbe im Elastischen Bereich bei Beiderseits Gelenkiger Lagerung

By Karel Koning and Josef Taub. Published in *Luftfahrtforschung*, July 6, 1933, p. 55. [A-1]

This analysis represents the first part of a cooperative project of the aircraft research institutes of Germany and Holland. It deals with

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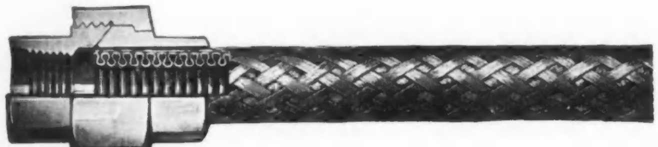

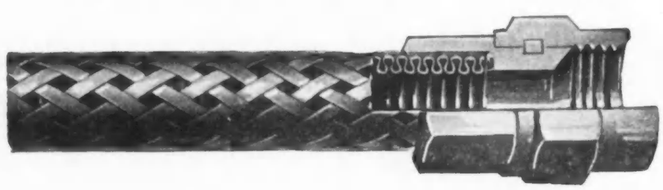

NOTES AND REVIEWS

Continued

buckling stress under impact, within the elastic range, of rods of small cross section, presenting first the general formulas and then the solution for the special case of a rod pin-jointed at both ends.

Flugmessungen zur Bestimmung des Einflusses der Oberflächenrauhigkeit

Heinrich Ebert. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Oct. 14, 1933, p. 529. [A-1]

To determine the influence of surface roughness on aerodynamic characteristics, flight tests were made with an airplane the surface roughness of which was gradually increased. From this the conclusion is drawn that the difference between model and full-scale flight test results is due mainly to surface roughness.

Die Entwicklungsrichtung der Flugeigenschaften

Joachim v. Köppen. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Sept. 28, 1933, p. 505. [A-1]

The trends in flight characteristics of aircraft since the war, that is, in stability and manouverability, are outlined and a forecast made of probable future developments. The guiding tendency is said to be toward greater safety. A few of the problems that must be solved are indicated.

Air Transport Manual

By the Staff of *"The Commercial Motor."* Published by Temple Press, Ltd., London, 1933; 184 pp., illustrated. [A-3]

A handbook of concise, practical and up-to-date information for all who are interested in the prospects of air-transport development in Great Britain.

CHASSIS PARTS

Automobile Electrical Equipment

By A. P. Young and L. Griffiths. Published by Iliffe & Sons, Ltd., London, 1933; 336 pp., illustrated. [C-3]

A complete survey of electric lighting, starting and ignition as applied to the internal combustion engine. Mr. Young, a member of the Society, explains in the preface that this book may be regarded as a logical successor to "Magnetos," since when the latter had run through a second edition, it was felt that the time had arrived to recast the whole book to embrace the complete electrical equipment used in association with the internal combustion engine, as now applied for travel on land, sea, and in the air.

ENGINES

Internal-Combustion Engines—Theory, Analysis and Design

By the late Robert L. Streeter and Lester C. Lichty. Published by McGraw-Hill Book Co., Inc., New York and London, Fourth Edition, 1933; 539 pp., illustrated. [E-1]

This edition of "A Treatise on Internal-Combustion Engines for Engineers and Students in Engineering," is a complete revision attempting to tie together in a comparatively small volume the theory, analysis, and design of internal-combustion engines. It contains many references to the voluminous results of researches into the different phases of internal-combustion engineering which have been published since the last edition of this book.

Engine-Cooling Research

By R. McKinnon Wood. Published in *The Journal of the Royal Aeronautical Society*, September, 1933, p. 733. [E-1]

In this paper, Mr. Wood has confined his attention to the air-cooled engine of the future as he imagined it a few years ago. Results of research conducted at the Royal Aircraft Establishment with the objective of developing this conception and assessing its value are described and the author's conclusions set down.

The Effect on Engine Performance of Change in Jacket-Water Outlet Temperature

By E. A. Garlock and Greer Ellis. N.A.C.A. Technical Note No. 476, November, 1933; 7 pp., 4 figs. [E-1]

Development of Air-cooled Engines with Blower Cooling

By Kurt Löhner. Translated from *Automobiltechnische Zeitschrift*, July 25, and August 10, 1933. N.A.C.A. Technical Memorandum No. 725, October, 1933; 32 pp., 31 figs. [E-1]

(Continued on page 28)

NOTES AND REVIEWS

Concluded

Problèmes Soulevés par l'Injection du Combustible dans les Moteurs Diesel, Notamment dans les Moteurs à Vitesse Variable

By R. Retel. Published in *L'Aéronautique*, October, 1933, L'Aérotechnique Section, p. 93. [E-1]

The research department of the French Air Ministry has selected *L'Aéronautique* as the medium for preliminary, unedited reports of its investigations. The object of these accounts is to make the information available while it is still timely, without the delay incident to the complete, authentic reports. The subject of this, the first of such articles, is to call attention to some factors frequently overlooked in the study of fuel injection in variable-speed Diesel engines.

Methode zur Feststellung des Mittleren Kraftstoffverbrauches der Fahrzeugmotoren

By Professor Wawrziniok. Published in *Automobiltechnische Zeitschrift*, Nov. 25, 1933, p. 573. [E-1]

An effort is here made to develop a method by which, from bench tests, may be ascertained fuel consumption and power data that will represent the average performance of the engine on the road. The necessary test conditions are stipulated and an exact method for evaluating the results is outlined and illustrated by an example. A practical, approximate method is also given.

Dieselmotoren in Neuen Triebfahrzeugen der Osterreichischen Bundesbahnen

C. Alexander Fieber. Published in *Sparwirtschaft*, October, 1933, p. 293. [E-1]

The Austrian railways have recently acquired two groups of Diesel-engined railcar, 10 two-axle baggage cars and 10 four-axle cars equipped with powerplants of 300 hp. and 160 hp. respectively. The author, who was in charge of the production of these vehicles, gives details on the design and performance of the engines.

Les Moteurs à Explosion à Grande Vitesse

By M. Sainturat. Published in *Journal de la Société des Ingénieurs de l'Automobile*, October, 1933, p. 2380. [E-1]

Thermal questions involved in the operation of high-speed internal-combustion engines are here analyzed with a viw to indicating how the results of science may be utilized in practice. Four lines along which improvement is required are pointed out. The elements of power, physical preparation of the fuel, detonation and vibration are the topics dealt with.

MATERIAL

Creep and Structural Stability of Nickel-Chromium-Iron-Alloys at 1,600° F.

By W. A. Tucker and S. E. Sinclair. Published in the *Bureau of Standards Journal of Research*, June, 1933. [G-1]

A study was made of the creep characteristics at 1,600° F. (870° C.) of fifteen alloys covering a range from 1 to 74 per cent nickel and from 3 to 55 per cent chromium. The results were compared with those of a previous investigation at 1,000° F. (538° C.) on similar alloys.

The Materials of Aircraft Construction

By F. T. Hill. Published by Sir Isaac Pitman & Sons, Ltd., New York and London, 1933; 363 pp., illustrated. [G-1]

The material contained in this volume is presented primarily to students of Aircraft Engineering, particularly to those interested in the various problems arising in the design of aircraft. It covers the ground in as complete a manner as is to be expected in a book of this description and size, and the contents are of use to aircraft designers and builders both for reference and review.

Reports on the Progress of Naphthology, 1932

Published in the *Journal of The Institution of Petroleum Technologists*, June, 1933, p. 427, and July, 1933, p. 549 [G-1]

This series of reports covers recent progress on the various phases of and problems connected with the production and utilization of petroleum products. Of special interest to the automotive engineer are the following, all of which appeared in the July issue: Motor Spirits and Light Distillates, by D. A. Howes; Gasoline Engines and Knock Testing, by R. Stansfield; Lubricants and Lubrication, by A. R. Bowen; Gas Oil, Diesel Fuel Oil and Fuel Oil, by F. H. Garner; Oil Engine Development, by P. N. Everett; Analysis and Testing, by W. H. Thomas, and Standard Methods of Testing Petroleum and Its Products, by J. S. S. Brame.

News of the Sections

- Springs on Two Programs
- Cleveland Sponsors Course
- New Tire Problems Solved
- Diesel High Spots Traced

Wells and Townsend on Program At National Motor Boat Dinner

● Metropolitan

FACTS and humor went "full speed ahead" at the first National Motor Boat Dinner, sponsored by the Metropolitan Section and held in New York Jan. 23, on Tuesday of Motor Boat Show Week. "Probably the first naval architect was old man Noah," said John H. Wells, naval architect, the first speaker at the dinner.

George H. Townsend, president of the American Power Boat Association, invited the engineers present to "safeguard their health and increase their engineering experience" by attending the International Motor Boat Races to be held in Florida in March.

These races being held under the auspices of the Smyrna, Miami and Palm Beach Yacht Clubs, Mr. Townsend regards as being the most important of the International races because of the number and variety of the foreign drivers participating.

"We are in a most unfortunate position in this country in regard to motors for inboard boats," said Mr. Townsend.

"In Europe they can—I am speaking of racing engines of course—step out and put in a Hispano-Suiza, Fiat or Napier and find in them a water-cooled engine perfectly capable of being adapted to motor boat racing purposes.

"In this country practically all of our airplane-engine development has been along the line of radial air-cooled engines. In consequence of that we are really very limited in our choice of engines for boat racing. There is virtually only one make available and usable."

Mr. Townsend pointed out that "squeezing" 400 to 600 hp. from an engine was regarded as quite a feat in this country, whereas in Europe, engines of 1200 to 1500 hp. are a commonplace in aviation and marine use. The power plant in a boat being brought to the International races by Count Razi, he said, will consist of two super-charged, 16-cyl. Maserati racing-car engines.

American chances in the speed trials were regarded as good by Mr. Townsend, in spite of heavy foreign competition in several departments. In the International 12-liter engine class (about 720 cu. in.) "our nearest equivalent is the Gold Cup class engines of 625 cu. in. It would seem that the American boats would have little chance against boats of nearly 100 cu. in. greater capacity, but at the same time, Captain Wanamaker's boat at Lake Garda last year was only 22 sec. behind in a 35-mile race.

"I have a very distinct feeling that both in the inboard and the outboard class the invaders are going to know they have been in a boat race before they are through," said Mr. Townsend.

He reviewed briefly some of the outstanding new things at the Motor Boat Show. Development of small electric launches and of a small engine for tenders he regarded as being of equal importance in the boat field to the showing of knee-action wheels and air-flow bodies in the automobile field.

In speaking of the development of a horizontal, 2-cycle Diesel engine which was shown, he said: "I cannot help but feel that even in the gasoline field a horizontal engine would be welcome, particularly in sailing auxiliaries, where the engine could be placed in the stern and a V drive used."

An automobile in streamline form is nothing more than a yacht turned upside down with automobile wheels put on the deck part of it, according to Mr. Wells, who spoke first on the program.

In a more serious vein he pointed out that hull form in boats is dependent to a certain extent on engine developments. "We have made our bottoms to fit the kind of engines we are able to get today, with increased power and weight to take care of," he said.

"I feel that the engine-builder's responsibility does not end when the engine leaves the test room, because I feel that the engine builder is just as much a partner of ours as we are his."

The questions of exhaust and Diesel engines were singled out for special attention by Mr. Wells.

"I do not think we know anything about the exhaust as yet," he said. "We have certain displacements of gas that have to be dissipated in some way or another in the air. As the trend goes toward the smaller Diesels you are going to have such a stench from the present gas that a harbor full of Diesel yachts is going to be an abomination.

"I think that someone will finally design an exhaust system with an exhaust-chamber in the boat. The exhaust could come out just ahead of the propeller, and the suction would take care of all the exhaust which came out of the engine. That may be the answer to engine thumping—which we haven't found yet."

The third feature on the motor-boat program was based on the old sea cry of "'ware sharks!" Captain William Young, who has hunted sharks for a living in many waters, gave a lecture, with motion pictures on "Tigers of the Sea."

About a hundred members of the Society and guests attended the National Motor Boat Dinner. Souvenirs like those distributed at the annual dinner of the Society were provided through the Metropolitan Section.

W. E. John, vice-chairman of the Metropolitan Section, headed the committee which arranged and ran the dinner. Sid. G. Harris, vice-chairman for the Marine Activity of the Section cooperated in the arrangements. Walter S. Peper is chairman of the Section.

Holds Diesel Fuel Costs Will Rise

● Northwest

Diesel fuel costs may increase to a point where the per-gallon price is on a parity with gasoline, but the additional mileage possible with Diesel engines would still be an economy factor, providing that a satisfactory engine is developed for the light car field. Prof. G. S. Wilson, Mechanical Engineering College, University of Washington, advanced this opinion in discussing "Combustion Conditions in a Solid-Injection Engine" at the Jan. 12 meeting of the Northwest Section, held in Seattle.

Sherman Bushnell, Section chairman, presided at the meeting, which was attended by about 80 members and guests.

The Diesel for wide use would probably be of the auxiliary air-chamber type, Professor Wilson said, and pointed out that manufacturers are now experimenting with low-pressure engines to combine the use of heavy fuels with spark ignition.

During the question period following the paper, almost every phase of the Diesel problem was touched upon. Professor Wilson spent considerable time on the theory of his subject but did not neglect recent applications of Diesel engines.

Critical Temperatures Studied by Abbott

● Cleveland

A small part of the results of an immense amount of experimental research upon the effect of various elements on the physical properties of steels was given at the Dec. 11 meeting of the Cleveland Section, held jointly with the Cleveland Section of the American Society for Steel Treating. Robert R. Abbott, metallurgical engineer, White Motor Co., gave an unpublished paper on "A Mathematical Determination of the Effect of Various Elements upon the Upper Critical Temperature (Ac_3) of Steel," which was well received.

A written commentary on Mr. Abbott's paper was read by H. A. Schwartz, National Malleable and Steel Casting Co., Cleveland.

Mr. Abbott's paper summarized experiments upon approximately 400 steel bars collected from steel makers all over the world.

Possibility of $700 Plane Discussed at Big Meeting

• Philadelphia

HOW the Aeronautics Branch of the Department of Commerce is assisting the aircraft industry toward the development of a small airplane for quantity production was outlined by F. R. Neely, chief of the aeronautic information of the Branch, at a meeting of the Philadelphia Section held Jan. 17. The project, which has aroused wide attention in the daily press, was to be described by Eugene R. Vidal, director of the Aeronautics Branch, but he was prevented from being present at the meeting by the necessity of attending a Congressional committee meeting.

Mr. Neely indicated that the project for a cheap plane is part of a coordinated effort by the Branch to widen the scope and availability of American aviation. Public works administration money is being used to grade about 2000 landing fields, which will bring the total of airports and landing fields in the United States to about 4000. The mileage of lighted airways is being increased and the Department hopes that problems incidental to the construction of a seadrome system for scheduled trans-ocean service will be worked-out satisfactorily.

The next logical step, Mr. Neely said, was to make airplanes available to a large number of people. Questionnaires were mailed to 34,000 pilots, mechanics and student pilots on the Department's list. They were asked whether they would buy an airplane costing in the neighborhood of $700 if it met safety tests and certain other qualifications. Eighteen thousand replies were received. Of these 13,000 said that they would buy such a plane. Three-thousand of the replies listed specific things which a plane would have to incorporate before they would purchase it.

Information received from the questionnaires was compiled and sent to aircraft manufacturers. The Public Works Administration, on the basis of evidence that a large potential market existed for a cheap plane, appropriated $500,000 for study of the project. This money is now available, and with the approval of 22 aircraft manufacturers, committees have been named by Mr. Vidal to study various phases of the problem of producing a cheap airplane in quantities of not less than 10,000.

Discussion of the information supplied in Mr. Neely's talk was animated, and mostly favorable. The difficulty of designing a plane to meet such a price as $700, at the present state of the art, was pointed out, however, by several engineers present at the meeting.

More than 200 persons attended the meeting, to which the Aircrafters, a Philadelphia organization of aircraft technicians, were invited. W. Laurence Le Page, vice-president in charge of engineering, Kellett Autogiro Corp., presided.

Warner Outlines Progress in Cars

• Canadian

Streamlining and independent springing of front wheels are the two most important developments made in the designing of motor cars during the past year and give promise of further improvements in the near future, John A. C. Warner, general manager of the Society, told the Canadian Section at its Jan. 18 meeting, which was held during the week of the National Motor Show in Toronto. A hundred members and guests of the Section attended the dinner at which Mr. Warner spoke.

Greater steps in streamlining will be seen next year, Mr. Warner said, following the definite advanced alterations of models seen at the 1934 shows. For the first time, he said, construction of motor cars had been based upon the sound principle of building the car to accommodate the passenger instead of following the practice of building the car and "sticking the passengers in wherever you could."

"This year shows us the development of cooperation between the sales department and the engineers," said Mr. Warner. "Passenger comfort is paramount in the new streamlined models. The cars are built around the passengers. In addition, principles which cut down wind resistance and alleviate suction at the rear are being followed. There has been a big change this year; there will be even bigger changes next year.

"The eventually desirable thing is to place the engine at the rear and that, engineers seem agreed, will come. It has been a hard job to follow the new principles and still not upset public confidence, but it has been done."

There is developing a very definite idea in the mind of the customer that the automobile is becoming too complicated. This was the message left with the Canadian Section by H. A. Brown, vice-president and general manager, General Motors of Canada, Ltd., who spoke at the Dec. 20 meeting.

In describing the "customer-research" activities (which began in Canada) of his Corporation Mr. Brown said that several hundred thousand questionnaires had been mailed to Canadian motorists in the last year and a half, in order to determine how they wanted their automobiles built.

When the information from the questionnaires is compiled in a special department, it is furnished to the engineering department as speedily as possible.

"The boys in that department are now about as familiar with the demands of the public as is our sales department," he said, following an earlier remark "I feel that engineers generally are too prone to concern themselves only with their own mechanical problem rather than to make an attempt to fully realize the problems of the customer."

Two hundred and twenty attended the meeting at which Mr. Brown spoke.

Canadian Territory Increased

It was announced by Mr. Warner at the January meeting of the Canadian Section that the Council of the Society had agreed to the inclusion of the provinces of Ontario and Quebec in the territory from which the Canadian Section may draw membership.

Diesel Highspots Traced by Cooke

• Syracuse

"The general tendency in the development of Diesel engines has been toward increasing the output from a given piece of equipment and, by fineness in design, to reduce the weight and the size and increase the efficiency. There has been a continual simplicity of the various details in all these things to stimulate its further development and broaden its field for use."

These were the conclusions of Harte Cooke, engineer, McIntosh and Seymour Corp., Auburn, N. Y., who spoke on "Advances in Diesel Engines" at the Jan. 8 meeting of the Syracuse Section.

"In England they hope to develop eventually Diesel engines of 3000 hp. which will weigh about 3 lb. per hp., for use in very large hydroplanes", Mr. Cooke said.

He rapidly reviewed the highlights in Diesel development from the original work of Dr. Diesel. Publication of the first work on the Diesel cycle was one of the few instances, he pointed out, where a complete and successful theory had been worked out before practical experimentation began.

Hale Discusses New Tire Types

• New England

There is a distinct tendency for independently-sprung front wheels to camber excessively on curves, causing a pronounced tire squeal, James E. Hale, manager, development department, Firestone Tire and Rubber Co., told a meeting of the New England Section held Jan. 9. The problem has been overcome, he indicated, by rounding the corners of the non-skid projections on the tread of the tire which, incidentally, decreases gravel-throwing proclivities which it might have.

Mr. Hale gave it as his opinion that the so-called "doughnut" tire is impractical. He claimed that it was unwieldy, introduced steering difficulties, reduced gasoline mileage, and set up flexing stresses to shorten tire life. He felt that such tires did stir up interest, however, which combined with the existing style trend, was at least partly responsible for the present small-diameter rim mounting a larger cross-section tire.

Seventy-five attended the meeting at which Mr. Hale spoke. John F. Duby, manufacturer of wheel alignment gages, and Irvin F. Richardson, automotive engineer, Standard Oil Co. of New York, were prominent in the discussion. A sound picture called "Competitors" sponsored by Standard Oil Co. of New York was shown.

Oils and Humor Blend on Program

• Baltimore

Herman C. Mathis, automotive lubrication engineer, Gulf Refining Co., Philadelphia, was the speaker at the Jan. 4 meeting of the Baltimore Section. His subject was "Lubricants and Fuels." Mr. Mathis is an affiliate-member representative in the Society.

The sixty-five members and guests who attended the meeting also heard Ira F. Thomas, coach of the Philadelphia American League baseball team. Mr. Thomas's talk was humorous in character.

Independent Spring Development Told

● Metropolitan

IN studying the principles which govern riding-comfort it was found that the controlling features are: 1. Reduction of front-end frequency. 2. Proper weight distribution. 3. Correct control of body movement. 4. Low-pressure tires. These were points made in a paper on "Principles Underlying the New Ride of the 1934 Buick" by F. A. Bower, chief engineer, Buick Motor Co., and W. J. Davidson, engineer, General Motors Corp., read at the Dec. 21 Meeting of the Metropolitan Section by Mr. Davidson.

A paper on "Automobile Control and the Transmission Problem", by E. S. Hall, was also read at the meeting. Extracts from Mr. Hall's paper were given in the January issue of the S.A.E. JOURNAL.

In reading the joint paper, Mr. Davidson covered in some detail the problems encountered in the development of an independent front-wheel suspension system which was designed fundamentally to improve riding quality of a car. He pointed out that in the 1933 model Buick, which employed conventional suspension, the rate of the front springs was approximately 300 lb. per in., and of the rear springs, approximately 150 lb. per in. Early experiments indicated that reducing the front-spring rate to that of the rear gave good riding qualities but brought new problems of uncomfortable and unsafe steering.

Several types of independent front-wheel suspension were investigated, and it was decided to use a variation of the parallelogram construction. This necessitated an entirely-new frame procedure. The front end of the frame had to be very rigid, and it was found that when no frame weave was allowed at the front it naturally worked back along the frame until a place was found where it could weave. This was just back of the line of the dash, and caused a bad body shake. The frame was, therefore, reinforced by placing braces between the "X" bars and the frame side members. All frame weave was thus eliminated.

It was found that the suspension mechanism can be designed to allow practically any amount of spring ride. Buick's experience was that 4 in. compression and 4 in. rebound is all that is necessary.

According to Mr. Davidson, the engineer now has complete control of the frequency of car movement, and can limit it to the factor necessary for perfect riding comfort. As a corollary to this he said that rear springs would not be benefited by independent suspension because they are already low in rate.

With the spring-rate under control, it was desired to obtain all benefit possible from a redistribution of the car's sprung weight. It was found by Buick that when the ratio K^2/ab gave a factor of 0.8, the ride was most desirable, although many engineers hold that the factor should approach 1 as nearly as possible. The car's weight has been distributed as nearly equal on front and rear wheels. This caused a marked improvement in riding comfort and balance, Mr. Davidson said.

Other problems were described by Mr. Davidson, in part, as follows:

"While the center of gravity of the Buick cars is slightly to the rear of the geometrical center it is not far enough to compensate for the entire weight transfer during braking from high speed. Under this condition there was a tendency for the front end to duck down. The installation of rubber bumpers inside the coil springs prevents this ducking action. The rubber bumpers being soft enough and of such a shape as to allow no bump as the rubber came into action. The brakes were also designed to allow slightly more braking on the rear wheels than on the front, thereby providing the proper brake balance by compensating for the weight transfer.

"With the independent suspension there is considerable spring travel and it was found necessary to help dampen this movement by the installation of rubber bumpers inside the coil springs to take care of compression, and rubber bumpers on the frame to take care of rebound. The pick-up of these rubber bumpers is such that no shock is experienced, it being impossible to tell when they come into action.

"After the shock-absorber control has been established it was found that due to flexible springing, body roll or sway from side to side was more pronounced. This led to the installation of a sway stabilizer which controlled side sway and kept the frame level. This also had a beneficial effect on steering in connection with the independent wheel suspension, as the front of the frame did not tip side to side as the wheels moved up and down.

"The steering of the first cars built incorporating the independent suspension was not all that could be desired. They lacked the proper directional control. Directional control was benefited by an increase in castor angle but as castor angle was increased, turning effort was also increased, producing a job which was too hard to handle on turns with the regulation 1933 production steering gear.

"Steering gear lash has to be as close to zero as possible."

Cleveland Sponsors Lubricants Course

A SERIES of six lectures and demonstrations on the general subject of lubricants has been arranged by the Cleveland Section for its members and others interested. The course will be available without cost to the members. A charge of $5 is being made to non-members who wish to share its benefits.

Dr. C. F. Prutton, associate professor of chemistry, Case School of Applied Science, is conducting the course, which will be given in the Bingham Mechanical Laboratory at the School. Eighty persons enrolled for the course before it began and several others are expected to attend the later lectures. Section officers report increased interest in S.A.E. membership as a result of the activity.

There are available at the Case School the Timken and the General Motors extreme-pressure lubricant testing machines. Data from these will be correlated with results from the earlier methods of testing.

The members of the Section Educational Committee who are arranging and promoting the course are: Hoy Stevens, chairman, Cleveland Railway Co.; Logan B. Helm, Standard Oil Co. of Ohio; A. K. Brumbaugh, the White Co.; and Ben H. Blair, Eaton Mfg. Co.

Manufacturer Outlines Metallurgy of Springs

● Pittsburgh

Additional information on independent springing of front wheels, particularly the metallurgical considerations, was supplied at a Pittsburgh Section meeting Jan. 16.

Willard Haight, engineer, Buick Motor Car Co. read the paper by W. J. Davidson and F. A. Bower which had been previously presented to the Metropolitan Section (see report of Metropolitan Section December meeting in this issue). A brief paper on "Quality of Steels Used in Independent Springing" was read by C. F. W. Rhys, assistant to the president, Carnegie Steel Co.

Mr. Rhys stated that surface requirements of the bar stock for the coil chassis springs used with the new types of suspension were the most exacting ever demanded from any steel manufacturer. Extreme care in billet preparation and absolute metallurgical control in production is required, said Mr. Rhys, with grain size of paramount importance.

Using 92-60 silico-manganese steel for Buick and electric-furnace molybdenum-carbon steel for Chrysler, bars are rolled and centerless ground, removing about 0.019 in. of the surface. Experiments have also been made with other types of electric-furnace, acid, and basic open-hearth steels. Mr. Rhys explained that the steel in coil springs is in torsion, instead of in tension as in leaf springs, hence different analysis and treatment are required.

Mr. Haight supplemented the paper he had read with a description of the fabrication of the coil springs. The stock is purchased to length and centerless ground. After flattening at both ends, it is heated to 1560 deg. in an atmosphere comparatively free from oxygen, so that no scale is formed. It is then wound on a mandrel and automatically stripped. Reheated for hardening, 1645 deg. for 45 min., it is placed in a rigid fixture to retain its shape and oil quenched at 175 deg. Again it is heated to 875 deg. for 90 min. A Brinell test of 0.280 to 0.300 is required.

After grinding at both ends at once to assure squareness, the spring is compressed fully, released and measured for free height. It is then rustproofed by washing in cold water and hot water, then bonderized and enamelled.

Active and interesting discussion after the showing of motion pictures was participated in by many prominent engineers and S.A.E. members, among them: C. F. W. Rhys, Carnegie Steel Co.; C. R. Hanna, Westinghouse Electric & Mfg. Co.; Oscar R. Wikander, Edgewater Steel Co.; Lee Oldfield, Indianapolis; M. E. Bushong, Hudson Motor Car Co.; Maurice Stubnitz, Fort Pitt Spring Co.; R. N. Austen, Iron City Spring Co.

One hundred and thirty-seven members and guests gathered for dinner, with a total of nearly three hundred for the technical session.

Antiknock Fuel Demonstrated in Lab

● Kansas City

A visit to the local laboratory of the Ethyl Gasoline Corp. was made Jan. 12 by the Kansas City Section. A paper on the "Development of Antiknock Fluids for Gasoline" was read by Mr. Nixon of the Corporation and M. E. Collins, director of the laboratory, demonstrated the use of regular and Ethyl gasolines in various engines.

The meeting was attended by 17 persons.

What Members Are Doing

Three members of the Society, *Miss Amelia Earhart, Dr. George W. Lewis* and *Edward P. Warner,* have been named to a committee of nine appointed by Daniel C. Roper, Secretary of Commerce, to aid in developing a mass-production, inexpensive airplane. The Public Works Administration recently appropriated $500,000 for the study of the possibilities of marketing a cheap plane. Eugene L. Vidal, aeronautic director of the Department of Commerce, has estimated, from a survey made by his office, that a potential market for 50,000 such planes exists, if they can be sold for a price approaching $750.

Yutaka Hara is on active service with the Japanese Navy as lieutenant-commander, engineering. His address is Taura Kanagawaken, Japan. Mail may be addressed to 368 Zaimokuza Kamakura Kanagawaken, Japan.

Ewing D. Nunn is engineer for the Muter Co., Chicago. He was vice-president of the Radio Parts Co., Milwaukee.

Arthur O. Dady is chief engineer, stoker division, the Butler Mfg. Co., Kansas City, Mo. He was formerly president and chief engineer of the Delta Stoker Co., North Chicago, Ill.

Frank Bishonden is practising as a consulting automotive engineer in Brisbane, Queensland, Australia. He was chief works engineer, Howard Motors, Ltd., in Brisbane.

W. H. Leininger has moved to Detroit, where he is connected with J. Stirling Getchell, Inc., 7310 Woodward Ave.

Frederic Saltzmann is chief engineer for the Clayton and Lambert Mfg. Co., Detroit.

Philip E. Pendleton's new address is West Augusta, Va.

Ralph J. Duckworth has been transferred from the Buick Motor Co. to the engineering department of the Olds Motor Works.

Donat A. Gauthier, consulting engineer, has returned from a tour of the European automobile shows and will be located at 4067 Clements Ave., Detroit.

Dale S. Cole is president and chief engineer, Dynamic Devices, Inc., Cleveland.

L. D. Seymour, president, American Airways, is a member of the code authority administering the Code of Fair Competition for the Air Transport Industry.

Edwin F. Papworth, formerly general manager of the Brown-Lipe-Chapin Division, General Motors Corp., was appointed resident comptroller of the Winton Engine Co., Cleveland, on Jan. 1. The Winton company is also a General Motors interest.

Contact

"Keep in touch with headquarters" is an excellent maxim for S.A.E. members, as well as for those in the military services. Society services to individual members are expedited when the Society is informed promptly of a member's change of address, change of position, or additional professional experience.

"What Members Are Doing" is a department which depends upon our hearing from members. Items printed here are verified by correspondence. Please answer such correspondence promptly, and send us your personal, professional news as soon as possible.

Relevant correspondence addressed to any department of the Society will be referred to the JOURNAL if it contains personal news.

T. C. Pitts, formerly president of the Aircraft Sheet Metal Co., Wichita, Kan., and recently with the Bellanca Aircraft Corp., New Castle, Del., is now connected with the General Aviation Corp., Baltimore.

Allan Robert Currey is president and chief engineer of Industrial Utilities, Ltd., Montreal, Que. He was general vehicles supervisor, eastern area, Bell Telephone Co. of Canada, Ltd.

William A. Morgan is manager for Jimmy Dixon's Super Service in San Diego. He was manager of the retail branch store in San Francisco of the Chevrolet Motor Co. of California.

Roy Tompkins, who was associated with the Reliance Machine and Motor Co., Brandon, Manitoba, is now manager of the Deer Lodge Service Garage, Winnipeg.

Max H. Schachner is with the Caterpillar Tractor Co., Peoria, Ill., as sales engineer.

E. D. Herrick

E. D. Herrick has rejoined the Lycoming Mfg. Co., Williamsport, Pa., as project engineer. Recently he was vice-president in charge of sales, Johnson Bronze Co., New Castle, Pa. In his previous connection with Lycoming he was chief engineer.

Julius Kuttner is with the International Harvester Co. in Chicago, manufacturing and developing Diesel Engines for tractors and trucks. Mr. Kuttner was a consulting engineer in New York before joining I.A.C. and was vice-chairman for the Marine Activity of the Metropolitan Section.

E. E. Sanborn is automotive engineer with the Gulf Refining Co., in New York. He was formerly employed in the same capacity by the Standard Oil Co. of New York.

M. R. Potter's address is c/o the Davis Cadillac Co., Scranton, Pa.

Harry W. McQuaid, formerly metallurgist, Timken-Detroit Axle Co., has joined the metallurgical staff of the Republic Steel Corp., Youngstown, Ohio.

H. W. McQuaid

William J. Cullen is utility division engineer with the Sinclair Refining Co., Chicago, after serving as staff engineer with the same company.

Fritz Mitschke has joined the Buick Motor Co. as tool designer. He was formerly production engineer at Leschnitz, Goerlitz-Land, Germany.

Deaths Reported

Deaths of the following members of the Society have been reported during the month preceding publication of this issue of the JOURNAL: Charles L. Carpenter, Capt., Q. M. Corps, U. S. Army, a member of the Society since 1921; Charles E. Wirth, (A'29), lubrication authority, American Oil and Supply Co., Newark, N. J.; Herbert T. Herr (M'12), vice-president, Westinghouse Electric and Mfg. Co.; Hayes Pettit; and C. R. Rinehart.

Joseph S. Oechsle

Joseph S. Oechsle (M'28), a consulting engineer of the Worthington Pump and Machinery Corp., died at the Hahnemann Hospital, Philadelphia, on Dec. 24, at the age of 39.

Mr. Oechsle was one of the founders and subsequently president of Metalweld, Inc., Philadelphia, manufacturers of portable air compressors, before that company was consolidated with Worthington in 1931.

Reports of Committees

Meetings Committee Report

TWELVE of the 365 days between Feb. 1, 1933, and Jan. 31, 1934, the period covered by this report, were devoted to general meetings of the Society.

The eight-day International Automotive Engineering Congress which was held in Chicago, Aug. 28 to Sept. 4, 1933, was the longest and in many respects the most outstanding event ever staged by the Society; and the Annual Meeting in Detroit, in January, 1934, at the close of the 1933 administrative year, was a four-day meeting with a comprehensive program in which each of the nine Professional Activities had a part. In addition to these twelve days devoted to matters of serious professional interest, the Society held one purely social event, the Annual Dinner, which took place at the Hotel Commodore, New York City, on Jan. 8, 1934.

The International Automotive Engineering Congress was more than a meeting; in reality, it was a succession of meetings, because the one event comprised, in addition to the usual Summer Meeting, a Transportation, a Production and an Aeronautic Meeting of the Society which in the years just past have customarily been held at different times and at a variety of places. The plan of holding these varied meetings at one place, in rapid sequence, on different days of the same week, made it possible for members to attend several or all of the meetings at a minimum expenditure of time and with a great saving of traveling expense.

During the crowded eight days of the International Automotive Engineering Congress, 24 technical sessions were held, at which 53 papers were presented. The programs for 22 of these sessions were arranged respectively by the nine recognized Professional Activities of the Society: one by the tractor engineers who later organized a committee which has since received Council approval, and one by the motorboat engineers. In addition to the 24 technical sessions just mentioned and the customary Business Session, a Century of Progress Dinner was held on the fourth evening (the meridian, as it were) of the Congress; and pleasant social relaxation was afforded by a Frolic, later in the week.

The initial days of the Congress were given over to the sessions sponsored by the Transportation and Maintenance, Motorcoach and Motor-Truck and Production Activities; the latter days were occupied by the sessions of the Aircraft and Aircraft Engine Activities; and the intermediate portions of the eight-day event were filled with the sessions of Passenger-Car, Diesel-Engine, Passenger-Car-Body, Fuels and Lubricants, Motorboat and Tractor engineers. This arrangement made it possible for a member, who was unable to stay in Chicago for the entire period, to reap the maximum benefit during such time as he found it practicable to remain at the Congress.

The Congress was genuinely international in character, as representatives of France, Belgium, Germany, Russia, Italy, Great Britain and the Far East attended the sessions, where they presented papers and took part, both formally and informally, in the various discussions inspired by the getting together of like-minded men from a diversity of environments.

One of the most successful features of the Congress was the Engineering Display, which attracted a large group of representative exhibitors and brought to the meeting a wide variety of technical products. Because of the interest and enthusiasm shown with respect to the Engineering Display, the Meetings Committee decided to hold a similar exhibition at the Annual Meeting.

At the four-day Annual Meeting, as at the Congress, each of the Society's Professional Activities took part in arranging the programs for the technical sessions. A total of 14 sessions was held, at which 35 papers were presented.

The Meetings Committee is duly appreciative of the cooperation furnished by the local Sections in relation to the general meetings. In connection with the International Automotive Engineering Congress, the Annual Dinner and the Annual Meeting, the Chicago, Metropolitan and Detroit Sections, respectively, rendered valuable assistance.

—ALEX TAUB, *Chairman*

Membership Committee Report

DURING the last year the Membership Committee has been very active and since September there has been a battle for leadership raging between the Sections. This is a friendly battle for the purpose of supremacy in obtaining paid up members. It is surprising how good have been the results. The new applications received have been of excellent calibre and the qualifications by payment of initiation fee and dues have been most encouraging. And the battle continues!

The following membership statistics are presented to show the details for 1933 as well as the comparative figures for 1932:

Membership by Grades for the Years Ending Dec. 31

	1933	1932
Members	3,507	3,450
Associates	2,144	2,087
Juniors	521	573
Foreign Members	349	317
Service Members	122	117
Departmental Members	2	1
Affiliate Members	93	95
	6,738*	6,640*
Affiliate Member Representatives	132	138
Enrolled Students	169	255
	7,039*	7,033*
Applications for Membership Received	321	637
Percentage of Applicants Qualifying	68	63

*Includes members placed on the Reserve membership Status.

The Committee wishes to express its sincere appreciation to the members and the Sections who have worked so diligently throughout the year to help maintain the membership in the Society.

—F. K. GLYNN, *Chairman*

Publication Committee Report

WITH the cooperation of members of the various activities committees, every effort was made to select for publication in the JOURNAL the best of the papers presented at the various meetings during the past year.

During the calendar year of 1933, 782 pages of text and 491 pages of revenue advertising were published in the JOURNAL. Of the text pages, 445, or approximately 56.9 per cent, consisted of papers and discussion; 408 of these pages were published in the Transactions Section. During the preceding year, 1932, 872 pages of text were published, of which 492 or 56.4 per cent consisted of papers and discussion.

Forty-one complete papers, some with discussion, and 5 discussions printed separately, were published during the year 1933. In addition, there were published 13 papers and articles in condensed form, 6 of which were of a technical character and 7 of which dealt with some of the broader phases of the engineer's problems.

Transactions

Transactions of the Society were brought up to date by publication about the middle of February of Volume 27 covering the year 1932. In this volume there were 512 pages. It contained 64 papers and 10 discussions printed separately. Of the 64 papers in this volume, 11 are classified as passenger-car design and research, 6 as engine design and research, 3 as oil engines, 2 as chassis parts, 6 as fuel and oil research, 12 as aircraft, 4 as aircraft engines, 6 as motorcoach and motor-truck, 1 as tractor, 1 as motorboat, 2 as materials, 8 as production, 1 as research, and 1 as miscellaneous.

Volume 27 was sold to members for $2, the charge being entered upon the bill for annual dues.

S.A.E. Handbook

The 1933 edition of the S.A.E. Handbook of Standards was issued to the members in August in the new standard size 5½ x 8⅜. This edition includes all of the new and revised standards adopted by the Society since the publication of the 1931 edition. About 40 of the older specifications that have become obsolete or were not used to any appreciable extent were discontinued by action of the Council. This edition of the Handbook has been widely circulated and favorably commented on here and abroad.

Roster

The S.A.E. Roster for 1933 contained 55 fewer pages than the 1932 Roster, this saving being effected by omitting the names of members on our Reserve Membership List. All the other information contained in the Roster for last year was retained. The 1933 Roster showed a total of 7001 members, including Affiliate Members, Affiliate Member Representatives and Enrolled Students. This total compared with 7238 in January, 1932.

The Roster for 1934 will be issued about the middle of February and will be similar in all respects to last year's book.

—GEORGE W. LEWIS, *Chairman*

Research Committee Report

BECAUSE of the necessity for keeping traveling expenses at a minimum, committee meetings during the past year were called only upon urgent demand and chiefly in conjunction with other meetings. In spite of this curtailment the activities of the Research Committee and its subcommittees occasioned eighteen meetings, and if the meetings of the Cooperative Fuel Research Committee and its subcommittees are included the total reaches thirty-six.

The progress reports of the year may be grouped under the following subject headings:

Front Wheel Alignment

Since January, 1933, the Front Wheel Alignment Research Subcommittee has been enlarged until the personnel includes a representative from practically every important automobile manufacturer.

The Committee has collected manufacturers' alignment specifications for 1933 cars and distributed the data to editors of technical and trade periodicals which publish passenger car specifications, in an effort to secure the widest possible circulation among independently operated wheel alignment service stations.

The present program of the Committee is concerned with:

(a) Bringing independent service stations into line on wheel aligning practice and assisting instrument manufacturers to do a better job.

(b) Serving as a clearing house for discussion of wheel alignment procedure by various manufacturers, thus avoiding confusion in the service field.

(c) Cooperating with State Motor Vehicle Departments in formulating uniform practice in testing wheel alignment of cars; and formulating a basic set of essential elements of front wheel alignment to serve as a guide to State Motor Vehicle Commissioners.

(d) Meeting new conditions imposed by future front-end changes, independent springing and large tires.

(e) Formulating and circulating to car manufacturers a questionnaire on details of practice in taking wheel alignment measurement with a view to bringing about more uniformity in the industry.

The Research Committee at its Sept. 2 meeting created a second division of the Front Wheel Alignment Subcommittee to deal with the wheel alignment problems of commercial motor vehicles in a similar manner to that in which the passenger car phase has been pursued.

Highways Research

In the absence of Federal funds for any considerable research program in cooperation with the Bureau of Public Roads, the Research Committee a year ago gave approval to the Highways Research Subcommittee's plan to contact with the highway administrators to carry on research work wherever possible.

The outcome of these contacts to date has been most gratifying and a basis for extensive cooperation in the broader fields of highway transportation has been established.

In the course of this undertaking, the need for study on the turning direction indicator problem has been brought forcibly to the attention of the Subcommittee. As a result of joint conferences with the Headlight Research Subcommittee, it was agreed that the first step should be a survey to determine whether or not turning direction signals are desirable. Toward this end the Subcommittee is considering the reports of experience with the use of indicators in Germany and England.

As a result of the Committee's contacts with the office of the Federal Coordinator of Transportation, Mr. Joseph B. Eastman has requested the assistance of the Highways Research Subcommittee in solving the technical questions encountered by his research staff which has been engaged for several months in the study of the so-called highway subsidy question.

Riding-Comfort

In the absence of an adequate research fund, Dr. F. A. Moss was able to continue only a very limited program of research concerned chiefly with a study of the problem of ventilation in relation to the presence of carbon monoxide particularly in buses.

"Automobile Body Refinements and Air Conditioning," presented by Dr. Moss at the Society's International Engineering Congress, indicates briefly a few lines of investigation that might profitably be undertaken in connection with automobile design for greater comfort.

The Committee at its last meeting requested Dr. Moss to continue some of the work he has started on tire pressures and types of seat cushion.

An effort is being made to arrange for more active promotion of the sale of the Wabblemeter with the hope that revenue obtained from that source will assist in carrying on a limited program.

Studies conducted at Purdue University, independently financed, have been reported to the Committee and are brought together in Bulletin No. 44 of the Engineering Experiment Station, Purdue University, entitled: "Riding Comfort Analysis," by H. M. Jacklin and G. J. Liddell.

Extreme-Pressure Lubricants

The results of the extreme-pressure lubricants research obtained during the past year are covered in two papers: "Apparatus for Determining Load-Carrying Capacity of Extreme-Pressure Lubricants," by S. A. McKee, F. G. Bitner and T. R. McKee, presented at the International Automotive Engineering Congress and published in the JOURNAL, December, 1933; and "Present Status of the Extreme-Pressure Lubrication Problem" by O. C. Bridgeman, scheduled for presentation at the Fuels and Lubricants Session of the 1934 Annual Meeting.

This project is being conducted at the Bureau of Standards under the direction of the Lubricants Research Subcommittee and has been financed by individual-company contributions.

In brief, a machine for testing the load-carrying capacity of extreme-pressure lubricants has been developed, tried out, and found convenient to operate. The results obtained on this machine are reproducible, and available data indicate that these results rate the lubricants in the order of their performance in service with regard to load-carrying capacity.

The Research Committee at its last meeting authorized the Lubricants Subcommittee to have tests made by the Bureau for load-carrying capacity on lubricants submitted, and through the Secretary of the Subcommittee, render reports on these tests to those supplying the lubricants, at a cost to the supplier sufficient to cover the expense of the testing at the Bureau and allow a fair return to the research fund. Such tests have been made on the orders received to date.

The Subcommittee also received approval of two other phases of its proposed program, namely:

(a) The building of a number of the load-carrying capacity test machines, upon receipt of firm orders from interested companies and organizations, for the purpose of conducting a cooperative series of tests to determine the reproducibility and significance of results with the machine and test method.

(b) Continuation and extension of the cooperative work to a study of wear and abrasion and the matter of stability of the lubricants.

Progress on the last two phases of the project has been delayed because of lack of funds, and further work must depend upon the outcome of the Committee's efforts to secure immediate contributions for the continuation of the research during 1934.

Crankcase Oil Stability

In accordance with the assignment of the Research Committee, the Crankcase Oil Stability Subcommittee held an organization meeting during the Society's International Congress. This meeting was followed by an informal meeting in New York and a symposium, for discussion of crankcase oil stability and an interchange of reports on the difficulties encountered by both the petroleum refiners and the engine builders, in October at the time of the American Petroleum Institute annual meeting.

This meeting in Chicago on Oct. 24 voted to request the chairman of the Technical Committee B of Committee D-2 of the American Society for Testing Materials to appoint immediately a subcommittee to consider and thoroughly digest all information which could be collected on this problem and report to the Crankcase Oil Stability Subcommittee at its January meeting.

This special committee met in November and agreed to conduct among themselves a series of tests by present methods on samples of crankcase oil of known performance characteristics, making an effort to secure the samples with service data from fleet operators, aircraft operators and others. The results of these tests will form the basis of the special committee's recommendation to the Crankcase Oil Stability Research Subcommittee at its January meeting.

Fuels Research

In addition to the Fuels Research Subcommittee's participation in the Cooperative Fuel Research through its representation on that Committee (the progress of which is reported under other headings), this Subcommittee, with the approval of the Research Committee, arranged for the organization of a volunteer committee consisting of one representative of each company or organization prepared to cooperate actively in a study of fuels for compression-ignition engines. It was understood that without reference to the Research Committee or the Fuels Subcommittee, this special committee without prejudice might, if it preferred, apply for sponsorship by one of the joint committees already organized.

This Volunteer Group for Research on Fuels for C.-I. Engines held an organization meeting and up to the present time has functioned independently.

Aviation Spark-Plugs

Funds have been made available recently for an investigation of aviation spark-plugs under the joint sponsorship of the Society and the Bureau of Aeronautics, Navy Department. The work is in progress at the Bureau of Standards and involves a study of methods of testing such spark plugs in the laboratory which is designed to furnish the Navy with information as to the suitability for aircraft-engine use of commercially-available spark plugs. In addition, a study will be made of the characteristics of spark-plugs and the causes of fouling.

Cooperative Fuel Research

The Cooperative Fuel Research, in which the Society has participated jointly with the American Petroleum Institute, the National Automobile Chamber of Commerce and the Bureau of Standards, for many years, has made progress during the past year on the following phases of the fuel problem: Detonation, Aviation

Gasoline Detonation, Alcohol-Gasoline Blends, Vapor Lock, Volatility, and Ice Formation.

(a) Detonation—The C.F.R. Motor Method was adopted early in the year by the American Society for Testing Materials as a Tentative Method of Test for Knock Characteristics of Motor Fuels (A.S.T.M. Designation: D 357-33 T).

The Subcommittee on Methods of Measuring Detonation has given study to an adequate means of determining whether a given C.F.R. knock-testing unit is in proper condition for making ratings by the Method. This included a series of cooperative tests among the members of the Committee and a special investigation at the Bureau of Standards of pure substances in an effort to find a hydrocarbon which will be free from the limitations of benzene which is now specified for the purpose.

The reproducibility of the Motor Method has also been checked in two series of tests among the members of the Committee and recently in a comprehensive test including all owners of C.F.R. Engines who wished to participate. The results of the Committee's tests were on the whole very good; the results of the recent series are at present being tabulated and analyzed.

Numerous details of the equipment were given further study and a simplification of the carburetor was perfected.

A report covering the work of the Detonation Subcommittee was presented at the World Petroleum Congress in London last summer and as a result of the contacts which the Committee's representatives to the Congress made with the members of the British Committee on detonation, a further program of road test correlation, providing for international cooperation, is being worked out.

(b) Aviation Gasoline Detonation—Early in the year a cooperative research project to investigate the subject of aviation gasoline detonation was organized and secured sponsorship under the Cooperative Fuel Research Committee. The object of this investigation is to develop a standard method for the detonation rating of aviation fuels which will be applicable to all varieties of fuels and to all types of spark-ignition aircraft engines. The tests are being conducted in the laboratories of four leading aircraft-engine builders, without expense to the Committee's fund; test fuels were supplied by individual petroleum companies; reference fuels, freight charges and the expenses incidental to the cooperation of the Bureau of Standards as a fifth engine laboratory, are being provided by a research fund subscribed by the petroleum industry. A detailed outline of the undertaking was presented at the Society's Engineering Congress in a paper, "Detonation Rating of Aviation Fuels", by Arthur Nutt.

(c) Alcohol Gasoline Blends—At the May 9 meeting of the Cooperative Fuel Research Committee the chairman was authorized to appoint a subcommittee consisting of six members, two representing the petroleum industry, two representing the automotive, and two representing outside interests, one of the last named being from the Bureau of Standards, to accumulate the data available and prepare a report. This subcommittee has since collected, analyzed and presented a summary report on all available data.

In addition to work done under the direction of this subcommittee, the Bureau of Standards has been conducting independent investigations on certain phases of the alcohol-gasoline blend problem including the water tolerance of alcohol-gasoline blends, and comparative fuel economy with gasoline and with alcohol-gasoline blends.

(d) Vapor Lock and Volatility—Since the presentation of the paper entitled, "The Vapor-Handling Capacity of Automobile Fuel Systems," by O. C. Bridgeman, H. S. White and F. B. Gary, presented at the 1932 Annual Meeting and published in the JOURNAL, April, 1933, a further analysis has been made of the data on vapor-handling capacity in order to evaluate the permissible vapor pressures at various altitudes.

A paper entitled "Economy through Fuel Selection," by O. C. Bridgeman was presented at the Automotive Engineering Congress. This paper covers both the volatility and vapor lock investigations of the C.F.R. Steering Committee and was written from the standpoint of fleet operation.

(e) Ice Formation—A study of the relation of fuel volatility to ice formation in the induction systems of aircraft engines has been under way at the Bureau of Standards, under the direction of the Cooperative Fuel Research Committee with funds provided by the Phillips Petroleum Co. The experimental work was completed last August and the results form the basis of a paper entitled, "Ice Formation in Aircraft-Engine Carburetors," by H. H. Allen, G. C. Rodgers, and D. B. Brooks, scheduled for presentation at the 1934 Annual Meeting.

—R. R. TEETOR, *Chairman.*

Sections Committee Report

THE demonstrated ability of the Sections to carry on creditably, and in some cases to gain ground, is brought out in a resume of the activities of the Sections for the calendar year 1933. The number and quality of the meetings held, the comparative attendance figures with those of the previous year, the cooperation of the local membership, bespeak fundamental health and stability and a keen and active interest on the part of the Section officers. One of the Pacific Coast Sections held 11 meetings last year; two other Sections staged 10 meetings, and two held nine meetings, the average number of meetings per Section being about six. Altogether, a total of 159 Section meetings were held from January to December, 1933, containing papers on subjects as listed below:

Aeronautics	12
Bodies	4
Chassis	6
Diesel	4
Fuels	11
*General	50
Marine	4
Metallurgy	5
Motorcoach and Motor Truck	7
Passenger Car	14
Powerplants and Equipment	20
Research	6
Service	3
Tires	2
Transportation and Maintenance	12

*The general meetings were on such topics as the mechanics of recovery, military automotive developments, lighting, safety and traffic, patents, and racing, and also included several inspection trips, student meetings, outings and social affairs.

The number of regular and probationary Sections remains the same, there being 20 regularly constituted Sections and two probationary groups—Kansas City and St. Louis.

The early part of the year, the Baltimore Section became affiliated with the Engineers Club of Baltimore. A like affiliation with the Technology Club of Syracuse was entered into by the Syracuse Section about a year ago.

During the past several months the Sections have been giving wholeheartedly of their cooperation in the membership increase endeavors of the General Membership Committee, and there is every evidence that this interest and activity will be sustained throughout the coming year under the guidance of the General Membership Committee. Membership Committees have been appointed by the Sections and the results indicated so far have been very favorable.

Many of the Sections have continued the placement work undertaken last year, and have appointed Placement Committees as an integral part of the regular Section organization.

There has been unusual activity in student circles this past year, and this is reflected in the number and quality of regular meetings held and the increase in membership in the various Student Branches. It is felt that the interest of the Sections in the colleges nearest them has had much to do with bringing this about, and the students have derived considerable benefit in the conduct of their own Student Branches through attendance at Section meetings and contact with the Section officers. The five Student Branches of the Society are located at New York University, Massachusetts Institute of Technology, University of Detroit, Ohio State University, and General Motors Institute of Technology.

HAROLD NUTT, *Chairman.*

Standards Committee Report

IN reporting the accomplishments of the Standards Committee during the past year, attention is called to the fact that conditions in the industry, although improving, have continued much as they were during the previous year so far as standardization activities are concerned. Approximately 100 subjects are on the Standards Committee docket, but the endeavors of the Committee have been concentrated on relatively few of the more important and urgent ones. The holding of numerous Division meetings, with the time and expense that would be incurred, has not been feasible and consequently the greater part of the standards work has been done this year by correspondence.

Division Reports

During the year eight Division and 10 Subdivision meetings were held in New York, Detroit, Chicago and Cleveland. Among the new specifications adopted by the Society, the more important are those for the new asymmetric type of automobile head-lighting and a tentative classification for the low-temperature crankcase oils, 10-W and 20-W. Important revisions were also adopted in the cast and wrought brass and bronze specifications and in the cast and wrought aluminum alloy specifications. An important revision was also made in the test requirements for aircraft nuts in conformity with requirements of governmental specifications.

Among the more important subjects in progress are extension of the storage battery specifications to include the newer type for motorcoaches and also general notes and instructions on battery testing equipment and procedure. Standard forms for distribution to the automotive industry for the collection of data on the lubricating specifications for new car models were developed and recommendations are being formulated for a new series of splined shaft ends for airplane propeller mountings; marine propeller shafts and wheel hubs; automobile signal-light and reflex reflector specifications and a classification for automobile chassis lubricants.

Work has continued in cooperation with the Radio Manufacturers Association toward development of standards for radio installations in automobiles and revision of existing standards, especially for ignition apparatus, that are related to the radio installation problem. A committee has also been studying standardization of a color classification code for automobile paints

and the most practical way in which to develop this project.

Special Projects

Important among special projects is that of developing a standard for the capacities and dimensions of gasoline tanks for tank trucks, with relation to the S.A.E. Standard CA dimensions. This work has progressed rapidly by the cooperation of committees of the American Petroleum Institute, the gasoline tank manufacturers and the Society and it is probable that a definite standard will be adopted soon for the present conventional type of motor trucks. The work will probably be continued to formulate further standards applicable to the short wheel-base type of motor trucks that are being developed to meet the weight and dimension restrictions imposed by many States.

Sectional Committees

Among the Sectional Committees for which the Society is a sponsor under the procedure of the American Standards Association, the more important projects that have been completed are a new standard for twist drills up to ½ in. diameter, additions to and refinements in the American Standard for Screw Threads and some extensions and revisions in the standards for ball and roller bearings. The Society is participating in new projects for the development of specifications and methods of test for safety glass and also for a standard method of classification and designation of surface finishes. The latter includes various types of finish on both metallic and non-metallic materials and the methods of surfacing such as machining, plasticising and coating.

International Standardization

The national standardizing bodies of foreign countries have been active during the year on a number of subjects, the more important of which affecting American interests being tires, rims and tire valves. The Society and the Tire and Rim Association, Inc., jointly represent American interests in this work.

General Activities

As in previous years the Society has continued active representation on a large number of committees of other organizations and societies concerned with projects that are of more direct interest to the automotive industries. News reports and in some cases the technical reports of Divisions of the Standards Committee, of sectional committees and of other committees on which the Society is represented, have been published in the S.A.E. JOURNAL and distributed by correspondence.

S.A.E. Handbook

A new edition of the complete S.A.E. Handbook was sent to the members in August. This was in the new standard size, 5½ x 8⅜ in., which conforms closely to the standard sizes used by a large number of technical publications and catalogs. This size was decided upon after careful investigation, as a better size for this type of publication and to effect maximum economies in printing. The new edition was widely circulated to the national standardizing bodies and to many engineering societies and associations in the principal foreign countries and to societies, trade associations, engineering colleges, State motor vehicle officials and others in the United States to whom the S.A.E. Standards are of direct interest. The change to the new size and arrangement has been very favorably commented upon by a large number of the members and others to whom this new edition was sent. It is planned to continue issuing supplementary reports of new and revised specifications in the interims between the new editions of the complete S.A.E. Handbook.

—A. BOOR, *Chairman*

COMPARATIVE BALANCE SHEET AS OF SEPT. 30, 1932, AND SEPT. 30, 1933

Assets	1933	1932
Cash	$ 14,093.13	$ 14,843.70
Accounts Receivable	9,045.34	10,313.85
Securities	*172,574.50	199,871.50
Accrued Interest on Securities	2,784.58	3,147.08
Inventories	757.40	780.25
Furniture & Fixtures	1,000.00	6,900.71
Items Paid in Advance, Charges Deferred	4,205.62	5,727.74
TOTAL ASSETS	$204,460.57	$241,584.83
Liabilities and Reserves		
Accounts Payable	$ 14,300.92	$ 9,643.44
National Dues & Miscl. Items Received in Advance	3,923.24	9,859.89
Reserves Set Aside for Anticipated Expenses	1,869.81	8,860.15
General Reserve	207,320.64	240,957.14
Net Unexpended Income	22,954.04[a]	27,735.79[a]
TOTAL LIABILITIES AND RESERVES	$204,460.57	$241,584.83

* Book Value (Market Value September 30) $151,941.25.
[a] Deficit.

Treasurer's Report

FOR the fiscal year just closed, the Finance Committee and the Council were in complete agreement on adopting a budget calling for a deficit of $17,057, and drawing on our securities to meet that amount.

Both the Finance Committee and the Council were too optimistic in budgeting the revenue for the year.

There was a decrease of $21,592 in income, over that budgeted.

This was due to the decrease in advertising, and membership dues.

Realizing as the year progressed, this drop in revenue the Council made every effort to reduce operating expenses. The operating expenses were cut $15,695 under the budget.

The end of the year showed a final deficit of $22,954, and securities were sold in the amount of $27,297 to provide necessary funds to meet the deficit.

The revenue for the year was $174,408, compared with $229,492, for the previous year.

The expense for the year was $197,362, compared with $257,228, for the previous year.

The cost of operating the Society for the year was 23 per cent below that of the previous year.

The revenue received was 24 per cent below that of the previous year.

Notwithstanding the fact that this is the third successive year that the Society surplus has been drawn upon, securities with a book value of $172,574 are still held by the Society. The security portfolio has been reviewed by the Finance Committee and the Council as well as by the Investment Counsel of the Bankers Trust Co. of New York, periodically during the past year and is being continuously reviewed during the current year, the Bankers Trust Co. being the depository.

All the securities are investments which are legal for savings banks and trust companies for the States of New York or Connecticut.

The comparative balance sheet as of Sept. 30, 1933, and the income and expense statement of that date, both of which are part of this report, show the complete details of revenue and expense. —DAVID BEECROFT, *Treasurer.*

INCOME AND EXPENSE AND BUDGET COMPARISON
FOR 12 MONTHS ENDING SEPT. 30

Income	1933	1932	1933 Budget
Dues & Subscriptions	$ 69,061.75	$ 83,849.75	$ 80,000.00
Initiation Fees	6,395.00	8,745.00	5,000.00
Interest & Discount	9,067.70	10,417.66	9,000.00
Advertising Sales—Journal	70,805.00	107,145.00	90,000.00
Advertising Sales—Handbook	3,500.00	2,750.00	2,000.00
Miscellaneous Sales	15,101.49	13,377.72	10,000.00
Profit or Loss from Sales of Securities	773.70[a]	93.25	....
Unused Portion of Section Dues	1,251.50	3,114.54	....
TOTAL INCOME	$174,408.74	$229,492.92	$196,000.00
Expense			
Research	$ 12,518.77	$ 12,381.03	$ 13,479.00
Standards	6,995.90	8,959.67	7,620.00
Publications	46,279.28	65,063.79	46,471.00
Sections	4,945.51	8,725.55	7,396.00
Meetings	14,173.14	24,232.82	21,039.00
Professional Activities	132.90	263.36	300.00
Cost of Membership Increase	8,809.85	12,268.11	9,453.00
Cost of Advtg. Sales—Journal	25,330.31	34,081.80	27,078.00
Cost of Advtg. Sales—Handbook	758.10	390.61	400.00
Cost of Miscellaneous Sales	6,324.66	4,904.08	4,410.00
General Expense	71,094.36	85,957.89	75,411.00
TOTAL EXPENSE	$197,362.78	$257,228.71	$213,057.00
Net Unexpended Income	22,954.04[b]	27,735.79[b]	17,057.00[b]

[a] Loss.
[b] Deficit.

Personnel of 1934 S.A.E. Committees

PRESIDENT D. G. ROOS announces the following appointments on the Administrative Committees of the Society and the personnel of the Professional Activities, Technical and Special Committees for 1934.

These include the Research Committee and its Subcommittees, the Standards Committee and its Divisions, the Society's Special Committees and Cooperative Committees on which the Society is represented with other organizations. Acceptance of their appointment has been received from virtually all of those named.

Administrative Committees

CONSTITUTION COMMITTEE

W. J. Davidson—*Chairman* (1 year)
B. B. Bachman (2 years)
J. H. Hunt (3 years)

FINANCE COMMITTEE

B. B. Bachman—*Chairman*
David Beecroft
H. M. Crane
C. L. Lawrance
C. B. Whittelsey

HOUSE COMMITTEE

A. W. Devine—*Chairman*
V. P. Rumely
T. R. Stenberg
C. S. Bruce
A. M. Wolf

MEETINGS COMMITTEE

Alex Taub—*Chairman*
A. L. Beall—*Vice-Chairman*
S. W. Bushnell
F. C. Horner
O. M. Thornton

Professional Activities Representatives

Aircraft	Peter Altman
Aircraft-Engine	H. K. Cummings
Diesel-Engine	F. M. Young
Fuels and Lubricants	Ferdinand Jehle
Passenger-Car	Alex Taub
Passenger-Car-Body	I. L. Carron
Production	Joseph Geschelin
Transportation	F. K. Glynn
Truck, Bus and Railcar	L. R. Buckendale

Section Representatives

Baltimore	John White
Buffalo	M. A. Thorne (Automotive)
	T. P. Wright (Aircraft)
	E. T. Larkin (Marine)
Canadian	N. P. Petersen
Chicago	R. B. May
Cleveland	Frank G. Alborn
Dayton	F. G. Born
Detroit	Vice-Chairmen
Indiana	A. W. Herrington
Kansas City	James Edwards
Metropolitan	Herbert Chase
Milwaukee	Arthur W. Pope, Jr.
New England	S. S. Burgey
Northern California	A. G. Marshall
Northwest	C. H. Bolin
Oregon	H. W. Drake
Philadelphia	James W. Cottrell
Pittsburgh	John J. McNally
Southern California	Lawrence J. Grunder
St. Louis	R. G. Burr
Syracuse	K. R. Trevor
Washington	James Fulton Fox
Wichita	T. A. Wells

MEMBERSHIP COMMITTEE

F. K. Glynn—*Chairman*
W. C. Keys—*Vice-Chairman*
J. F. Hardecker
J. G. Holmstrom
J. L. Stewart

Professional Activities Representatives

Aircraft	J. R. Cautley
Aircraft-Engine	N. N. Tilley
Diesel Engine	A. J. Poole
Fuels and Lubricants	A. L. Foster
Passenger-Car	W. C. Keys
Passenger-Car-Body	J. W. Votypka
Production	W. W. Nichols
Transportation	R. T. Hendrickson
Truck, Bus and Railcar	B. J. Lemon

Section Representatives

Baltimore	G. O. Pooley
Buffalo	Earl V. Schaal
Canadian	C. E. Tilston
Chicago	A. Vance Howe
Cleveland	H. E. Simi
Dayton	F. W. Heckert
Detroit	John W. Votypka
Indiana	Charles Merz
Kansas City	Roy Mason
Metropolitan	O. P. Liebreich
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Pittsburgh	Robert E. Behlen
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St. Louis	G. C. Stevens
Syracuse	W. A. Metzroth
Washington	Stephen G. Henry
Wichita	H. F. Brown

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G. L. McCain
P. C. Ritchie
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S. W. Sparrow

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W. H. Fairbanks (Southern California)
E. R. Fish (Syracuse)
Charles Froesch (Baltimore)
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Harlow Hyde (Indiana)
Maurice J. Kane (Northwest)
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S. M. McKee (Kansas City)
C. R. Noll (Pittsburgh)
W. A. Parrish (Chicago)
E. V. Rippjingille (Detroit)
P. C. Ritchie (Milwaukee)
L. P. Saunders*
E. V. Schaal (Buffalo)
S. B. Shaw (Northern California)
E. H. Swayze (Oregon)

*Members at large.

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G. W. Lewis
G. A. Page, Jr.
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A. S. Menasco
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A. E. Becker
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Harte Cooke
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C. C. Hinkley
G. W. Hobbs
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M. S. Huckle
Robert Insley
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W. F. Joachim
Carlton Kemper
E. T. Larkin
W. E. Lay
L. C. Lichty
A. A. Lyman
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J. G. Oetzel
Charles Oppe
A. J. Poole
A. W. Pope, Jr.
F. G. Shoemaker
C. F. Taylor
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Graham Edgar
A. L. Foster
Robert Insley
Ferdinand Jehle
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A. G. Marshall
L. V. Newton
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O. F. Graebner
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G. J. Monfort
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D. E. Gamble
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J. E. Padgett
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D. A. Wallace

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Clinton Brettell
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Henry Dakin
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R. T. Hendrickson
H. R. Holder
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A. A. Lyman
E. S. Pardoe
F. C. Patton
A. J. Scaife
T. C. Smith
M. F. Steinberger
E. L. Tirrell
J. F. Winchester
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L. R. Buckendale
F. F. Chandler
C. O. Guernsey
M. C. Horine
B. J. Lemon
W. L. Moreland
G. S. Piroomoff
W. D. Reese
A. W. Scarratt
H. E. Simi
H. G. Smith
C. W. Spicer
W. B. Stout
G. W. Thomas
B. F. Wright

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H. M. Crane
H. C. Dickinson
H. L. Horning
J. H. Hunt
H. M. Jacklin
W. S. James
Ferdinand Jehle
F. F. Kishline
Julius Kuttner
W. E. Lay
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T. B. Rendel
A. J. Scaife
T. C. Smith
S. W. Sparrow
W. B. Stout
Alex Taub
C. F. Taylor
O. D. Treiber
W. G. Wall
E. P. Warner
J. F. Winchester
A. M. Wolf
H. T. Woolson

CRANKCASE OIL STABILITY SUBCOMMITTEE

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H. C. Dickinson
G. W. Gray
G. R. Lord
T. C. Smith
R. R. Teetor

FRONT-WHEEL-ALIGNMENT SUBCOMMITTEE

B. J. Lemon—*Chairman*

(Passenger-Car Division)

F. F. Chandler
H. E. Churchill
James Dykstra
W. E. England
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Chronicle *and* Comment

By
Norman G. Shidle

GREETED by a strike of bell hops and elevator operators at the Book-Cadillac, the visiting engineers got plenty of excitement on the opening day of the meeting. About noontime most of the cooks walked out and everybody began speculating as to whether or not the weather would be warm enough for a picnic. Carnation-bedecked assistant managers and room clerks were carrying **bags and running** elevators, making each individual convention attender feel, for the moment at least, like visiting royalty.

WITH thirty-two committee meetings crowded into the four days of the meeting, many members found themselves moving constantly from committee problems to technical papers and back again to committee problems. The committees got plenty of things done this year at the annual meeting and the work of practically every department of the society has already gone into high. Reports of what went on in the meetings held in Detroit will be ready for publication next month.

THE engineering exhibit held adjacent to the meeting rooms was an unqualified success. The interest displayed by those attending the convention was even greater than that recorded at the first exhibit of this kind, held by the Society in Chicago last summer at the International Automotive Engineering Congress. So widespread were the favorable comments on this feature, that it seems almost inevitable that it will be repeated at many future meetings.

ENGINEERS seem to be learning the trick of presenting technical papers in an interesting fashion. An unusual number of papers were put over with a real punch at this meeting. Several of the speakers who did the best jobs in this respect, had the most highly technical of the papers presented. Session after session found listeners congratulating each other upon having come to the meeting in person, because they felt very definitely that the manner in which the papers were presented gave an understanding of the subject which could not possibly be absorbed in full through the printed word.

"If more and more of the men who read papers begin to give serious attention to their method of presentation as well as to the subject matter", one veteran convention attender was heard to remark, "it will do more than any single thing I can think of to make big sessions, such as we are having this year, standard at all of our meetings".

THE annual meeting, like the Chicago sessions of last fall, had a distinctly international flavor, despite the fact that there were no foreign engineers presenting papers. The Society was honored by the attendance of a number of important European technicians, among whom were: Erik Jern, A. B. Volvo, Gothenburg, Sweden; Ivan Ornberg, Maurice H. Sainturat, Citroen; Eugenio Winetti, Lancia; W. A. Robotham, Rolls-Royce.

NOT less than 125 people attended any session, while at least one session during the meeting registered an attendance well over the 800 mark. In spite of a rather heavy program in some sessions, debate and discussion took place in every case. Usually, in fact, the argument still was going on when the chairman of the meeting had to call time.

THE weather was fine and mild during all four days of the meeting. We take pains to record this fact, not only for the information of those who did not attend the meeting, but also for the information of the many who were there but failed to get their noses outside of the hotel. All in all, it was an extremely busy, interesting and successful Annual Meeting.

E. N. JACOBS, accepting the Wright Brothers medal at the dinner which concluded the annual meeting, remarked: "I have a very old car which, as an aeronautical man, I have pledged myself to run until a really streamlined car is produced." Then he added, wistfully: "I'm still running the old car and it isn't running very well—and the situation is getting critical!"

ALL the cars in the automobile shows this year can be divided into two classes, toastmaster L. C. Hill told the Detroit diners. "One consists of those that have bouncing wheels—the other of those that lost their nerve."

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 10, 1933, and Jan. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (S M) Service Member; (F M) Foreign Member.

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BENITZ, FRANK C. (A) transportation manager, Dugan Brothers, Inc., 267 South Fourth Street, Brooklyn, N. Y.; (mail) 95-06 72nd Avenue, Forest Hills, L. I., N. Y.

CAMPBELL, DONALD W. (A) International Harvester Co., Tractor Engineering Department, Chicago; (mail) 114 North Parkside Avenue.

DONOGHUE, F. FRANCIS (J) 60 Green Street, Worcester, Mass.

GONARD, JOHN L. (A) inventor, Englewood Cliffs, N. J.

GOTT, WILLIAM ALFRED (A) superintendent, service department, Jenney Mfg. Co., 12 India Street, Boston.

HAGERMAN, STANLEY D. (A) sales manager, alemite division, Stewart-Warner-Alemite Corp. of Canada, Ltd., Belleville, Ontario, Canada.

HEMMINGWAY, HUGH L. (J) CFR engine operator, Ashland Refining Co., Ashland, Ky.; (mail) Box 466, Catlettsburg, Ky.

HINCHCLIFFE, H. L. (J) chemist, Shell Oil Co. of Canada, Ltd., Montreal East, Quebec, Canada; (mail) 82 Broadway Avenue.

HOUGHTON, RALPH H. (J) inspector, body division, Packard Motor Car Co., Detroit; (mail) 680 Longfellow Avenue.

IRVING, PHILIP L. (M) tool design department, Mueller Brass Co., Port Huron, Mich.

JOHNSTON, E. J. (A) salesman, Shell Petroleum Corp., Detroit; (mail) Campus Hotel, East Lansing, Mich.

JUDD, MORTON F. (M) vice-president, Raybestos-Manhattan, Inc., Raybestos Division, Bridgeport, Conn.

MOORE, NEIL A. (M) assistant general manager, Sealed Power Corp., Muskegon, Mich.

STEELE, HOWARD B. (A) branch manager, Zenith-Detroit Corp., Detroit; (mail) 2631 North 62nd Street, Wauwatosa, Wis.

TITUS, ELWIN SHIRLEY (J) designer, partner, TMC Engineering Service Co., 17 East Washington Street, Iowa City, Iowa.

TUTT, CHARLES L., JR. (J) graduate student, Princeton University, Princeton, N. J.; (mail) 301 Nassau Street.

VAN LAANEN, F. J., JR. (A) treasurer, production and engine development, Green Bay Drop Forge Co., Green Bay, Wis.

WIENER, MAX L. (M) general manager, Wiener Body Co., 245 Raymond Boulevard, Newark, N. J.

Applications Received

The applications for membership received between Dec. 15, 1933, and Jan. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

BADERTSCHER, OTTO J., Badertscher Automatic Brake Corp., Jersey City, N. J.

BEEBE, MURRAY C., JR., recorder, Civil Works Control Survey, Norwich, Conn.

BUSSE, RALPH L., vice-president in charge of sales, The Timken-Detroit Axle Co., Detroit.

DEBEAUBIEN, WILLIAM J., engineering draftsman, Pontiac Motor Co., Pontiac, Mich.

EDWARDS, ALLEN F., president, Universal Products Co., Inc., Dearborn, Mich.

EVANS, EDWARD S., JR., vice-president, Evans Appliance Co., Detroit.

FOX, LELAND W., manager, service stores laboratory, Firestone Tire & Rubber Co., Akron, Ohio.

FOY, BYRON C., president, De Soto Motor Corp., Detroit.

FIELD, EMMET J., graduate student, University of Minnesota, Minneapolis, Minn.

FRIED, JOSEPH A., manager, industrial department, R C A Victor Co., Camden, N. J.

FROMM, HARRY E., sales manager, Chrysler Motors, Amplex Division, Detroit.

HALL, E. G., sales, Canada Wire & Cable Co., Ltd., Toronto, Ont., Canada.

HAMILTON, SAMUEL A. B., JR., automotive instructor, Fort Worth Vocational School, Fort Worth, Tex.

HASSEY, JOHN A., automotive superintendent, Cities Service Refining Co., Boston.

HOOK, HUGH O., manager, Standard Spring Co., Chicago.

ISOM, EDWARD W., vice-president, Sinclair Refining Co., New York City.

JOHNSON, WALTER DANIEL, owner, 121 East 18th Street, Kansas City, Mo.

KREULEN, HERMAN P., vice-president and treasurer, Spring City Foundry Co., Waukesha, Wis.

LITTLEFIELD, E. W., president, Littlefield Greene Corp., Boston.

LOMANOFF, F., in charge of technical bureau, Autostroy; c/o Ford Motor Co., Dearborn, Mich.

MACKENZIE, WILLIAM J., manager alloy sales, Youngstown Sheet & Tube Co., Youngstown, Ohio.

MILLER, ROBERT F., sales engineer, Noblitt-Sparks Industries, Inc., Columbus, Ohio.

MILLS, GEORGE W., sales promotion manager, Imperial Oil, Ltd., Toronto, Ont., Canada.

MINGES, A. J., junior designer, Busch Sulzer Diesel Engine Co., St. Louis, Mo.

MOTION, ROBERT, service station manager, Standard Oil Co. of N. J., Newark, N. J.

MURPHY, HOWARD F., mechanical engineer, Schwitzer-Cummins Co., Indianapolis, Ind.

NEVIN, THOMAS MARSHALL, test engineer, Stewart-Warner Corp., Chicago.

O'CONNOR, ROBERT J., salesman, The White Co., Kansas City, Mo.

ORTEGREN, HERMAN A., chief draftsman, Bower Roller Bearing Co., Detroit.

ORTMANN, FRED, electrician, W. H. Flaherty Co., Boston.

OTWELL, WILLIAM A., sole owner of company, Specialty Distributors Co., Detroit.

PROSSER, ROGER D., member of firm, Thomas Prosser & Son, New York City.

RAES, OSCAR MEDART, engineer, Chrysler Corp., Highland Park, Mich.

RIANHARD, JAMES LINCOLN, general sales, Standard Oil Co. of N. J., Baltimore, Md.

ROENSCH, MAX MOSS, experimental engineer, Chrysler Corp., Detroit.

ROSENTHAL, EDWARD, sales engineer, Wheels, Inc., New York City.

SHIMER, WILLIAM B., Schwitzer-Cummins Co., Indianapolis, Ind.

SQUIER, P. HARRY, secretary and factory manager, William and Harvey Rowland, Inc., Frankford, Philadelphia.

STRIBLING, JOHN WILLIAM, engineer, Anderson Mfg. Co., Cambridge, Mass.

TAYLOR, D. W., lubrication engineer, Seaside Oil Co., Summerland, Cal.

THOMSON, A. MORRIS, vice-president, Dardelet Threadlock Corp., New York City.

VAN SICKLE, JAMES, maintenance superintendent, Terminal Transportation System, New York City.

WAGSTAFF, WILLIAM A., refrigeration engineer in charge of acoustics, Norge Corp., Detroit.

WEISSENBACH, JOSEPH, JR., Mid-West distributor, Garland Products Co., St. Louis, Mo.

WELDGEN, RAY O., heat treat superintendent, Universal Products Co., Dearborn, Mich.

WINKELMANN, OTTO, test engineer, Adler-Werke, Frankfurt A/M, Germany.

WOOLSTEEN, ROBERT BRUCE, draftsman, Civil Works Project, City Engineer's Office, Peoria, Ill.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Aircraft Power-Plant Instruments

By Harcourt Sontag and W. G. Brombacher. N.A.C.A. Report No. 466, 1933; 57 pp., illustrated. Price, 15 cents. [A-1]

Wind-Tunnel Tests on Combinations of a Wing with Fixed Auxiliary Airfoils Having Various Chords and Profiles

By Fred E. Weick and Robert Sanders. N.A.C.A. Report No. 472, 1933; 20 pp., with tables and charts. Price, 10 cents. [A-1]

Strength Tests of Thin-Walled Duralumin Cylinders in Pure Bending

By Eugene E. Lundquist. N.A.C.A. Technical Note No. 479, December, 1933; 10 pp., 7 figs. [A-1]

The Drag of Streamline Wires

By Eastman N. Jacobs. N.A.C.A. Technical Note No. 480, December, 1933; 7 pp., 7 figs. [A-1]

The Reduction in Drag of a Forward-Sloping Windshield

By Eastman N. Jacobs. N.A.C.A. Technical Note No. 481, December, 1933; 4 pp., 4 figs. [A-1]

The Flight of an Autogiro at High Speed

By J. A. J. Bennett Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, No. 17, Sept. 14, 1933. N.A.C.A. Technical Memorandum No. 729, December, 1933; 14 pp., 12 figs. [A-1]

Trend of Airplane Flight Characteristics

By Joachim von Köppen. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, No. 18, Sept. 28, 1933. N.A.C.A. Technical Memorandum No. 731, December, 1933; 14 pp., 7 figs. [A-1]

The Characteristics of 78 Related Airfoil Sections from Tests in the Variable-Density Wind Tunnel

By Eastman N. Jacobs, Kenneth E. Ward and Robert M. Pinkerton. N.A.C.A. Report No. 460, 1933; 58 pp. with tables and charts. Price, 15 cents [A-1]

The N.A.C.A. High-Speed Wind Tunnel and Tests of Six Propeller Sections

By John Stack. N.A.C.A. Report No. 463, 1933; 24 pp., illustrated. Price, 10 cents. [A-1]

Negative Thrust and Torque Characteristics of an Adjustable-Pitch Metal Propeller

By Edwin P. Hartman. N.A.C.A. Report No. 464, 1933; 13 pp., illustrated. Price, 5 cents. [A-1]

The Experimental Determination of the Moments of Inertia of Airplanes

By Hartley A. Soulé and Marvel P. Miller. N.A.C.A. Report No. 467, 1933; 15 pp., with tables and charts. Price, 5 cents. [A-1]

The 1933 Contest for the Deutsch de la Meurthe Trophy

Airplanes Participating in the Contest

By Pierre Léglise. Translated from *L'Aéronautique*, July and August, 1933.

Engines Used on the Airplanes

By L. Hirschauer. Translated from *L'Aérophile*, June, 1933.

Lessons Learned from the Contest

By Raymond Saladin. Translated from *La Nature*, August, 1933. N.A.C.A. Technical Memorandum No. 724, October, 1933; 39 pp., 56 figs. [A-1]

Attaining a Steady Air Stream in Wind Tunnels

By L. Prandtl. Reprint from *Handbuch der Experimentalphysik*, Vol. IV, Part 2. N.A.C.A. Technical Memorandum No. 726, October, 1933; 34 pp., 26 figs. [A-1]

The Theory of the Strandgren Cyclogiro

By C. B. Strandgren. Translated from *l'Aérophile*, Vol. 41, No. 7, July, 1933. N.A.C.A. Technical Memorandum No. 727, November, 1933; 17 pp., 22 figs. [A-1]

Tank Tests of Two Floats for High-Speed Seaplanes

By Joe W. Bell. N.A.C.A. Technical Note No. 473, November, 1933; 6 pp., 9 figs. [A-1]

Effect of Stabilizer Location upon Pitching and Yawing Moments in Spins as Shown by Tests with the Spinning Balance

By M. J. Bamber and C. H. Zimmerman. N.A.C.A. Technical Note No. 474, November, 1933; 11 pp., 16 figs. [A-1]

The Effect of Split Trailing-Edge Wing Flaps on the Aerodynamic Characteristics of a Parasol Monoplane

By Rudolf N. Wallace. N.A.C.A. Technical Note No. 475, November, 1933; 8 pp., 9 figs. [A-1]

Aerodynamic Tests of a Low Aspect Ratio Tapered Wing with an Auxiliary Airfoil for Use on Tailless Airplanes

By Robert Sanders. N.A.C.A. Technical Note No. 477, November, 1933; 9 pp., 3 figs. [A-1]

The Effect of Slots and Flaps on Lateral Control of a Low-Wing Monoplane as Determined in Flight

By Hartley A. Soulé and J. W. Wetmore. N.A.C.A. Technical Note No. 478, November, 1933; 11 pp., 16 figs. [A-1]

Aerodynamic Forces and Moments of a Seaplane on the Water

by M. Kohler. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, No. 16, August 28, 1933. N.A.C.A. Technical Memorandum No. 728, November, 1933; 5 pp., 8 figs. [A-1]

Technischer Bericht über den Deutschlandflug 1933

By Leander. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, October 28, 1933. [A-1]

The German air races for 1933 are said to have amply fulfilled their purpose, to interest the entire group of individual sport flyers in Germany. Seventy-five entries competed, of whom a little more than half dropped out during the course of the meet. The methods of handicapping, conducting the tests and evaluating the results are described and data given on the performance of the aircraft and the causes for the eliminations before the completion of all events.

Praktische Erfahrungenaus Blitzschlägen in Flugzeuge

By Heinrich Koppe. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Nov. 4, 1933, p. 577. [A-1]

In this practical treatise on the danger from lightning in aircraft operation, the author gives data on the extent and nature of the menace from thunderstorms, the part played both by air pressure and electrical discharges, the influence of such design features as radio antenna,

structural types and ignition layouts and the nature of the damage suffered by aircraft. Recommendations are then made as to methods for securing protection from dangers by lightning.

Der Kleine Windkanal der DVL

By Friedrich Seewald. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Oct. 28, 1933, p. 559. [A-1]

The small wind tunnel built by the German Institute for Aeronautical Research during the current year, its equipment and method of operation are briefly described.

Une Utilisation de la Projection Stéréographique pour la Navigation Aérienne

By J. F. Cox and Max Cosyns. Published in *L'Aéronautique,* November, 1933, L'Aérotechnique section, p. 109. [A-4]

J. F. Cox in this article explains the principles involved in the determination, without calculation, of the position of an aircraft by the use of stereographic projection, a method developed by him; and Max Cosyns, who used the method in his stratospheric ascensions with Professor Picard, gives some practical details concerning its application.

ENGINES

Beschleunigungsmessungen an Kraftfahrzeugmotoren

By P. Langer and Dr. Marquard. Published in *Automobiltechnische Zeitschrift,* Sept. 25, 1933, p. 452. [E-1]

The engineering college at Aix-la-Chapelle has developed an engine test stand on which can be determined the accelerating performance of the engine as it would be developed in a vehicle on the road. This is done by loading the engine with the inertia of rotating masses representing the inertia of the vehicle and wind resistance. The development of the stand is explained and examples of results with a carbureter and a Diesel engine are given.

Über Verfahren zur Erhöhung des Oberflächenverschleisswiderstandes von Kurbelwellen

By H. Kallen and H. Schrader. Published in *Automobiltechnische Zeitschrift,* Oct. 10, 1933, p. 484. [E-5]

An investigation made by the Krupp company on methods of increasing the surface wear resistance of crankshafts is here reported. Three methods were tried, nitriding, case hardening and local chilled hardening.

MATERIAL

Development of the C. F. R. Knock-Testing Method

By T. A. Boyd and C. B. Veal. Presented at the World Petroleum Congress, London, July 19-25, 1933. [G-1]

This paper gives an account of the work done in the United States during the past few years, and under the auspices of the Cooperative Fuel Research Committee, which has resulted in the development of an apparatus and method for rating the antiknock qualities of automobile fuels in terms of octane number.

Detonation Rating of Aviation Fuels

By H. K. Cummings. Presented at the World Petroleum Congress, London, July 19-25, 1933. [G-1]

The author reviews various methods used in the United States to specify the detonation characteristics of aviation fuels, and calls attention to several studies of the correlation between laboratory ratings and the performance of fuels in multi-cylinder aircraft engines.

The Cooperative Fuel Research Committee through its Aviation Gasoline Detonation Subcommittee is sponsoring an investigation being conducted jointly by the aircraft-engine manufacturers, the gasoline producers and those Government agencies concerned with the quality of aviation fuel. The object of this investigation is to develop a standard method for the detonation rating of aviation fuels which will be applicable to all varieties of fuels and to all types of spark-ignition aircraft engines. The program is outlined by Mr. Cummings.

Mr. Cummings' paper and the paper by Messrs. Boyd and Veal listed above constitute the official reports of the Cooperative Fuel Research Committee to the Congress.

Other papers presented at the Congress of special interest to the automotive industry are the following:

Secondary Reference Standards for Knock-Testing

By A. E. Becker and C. B. Kass. [G-1]

The Effect of Temperature on Knock-Rating

By L. A. Peletier. [G-1]

Au Sujet Des Méthodes De Détermination De La Détonation Employée en France (Methods of Determining Knock Ratings in Use in France)

By P. Dumanois. [G-1]

Piezoelektrischer Druckindikator für Klopfversuche am Verbrennungsmotor (Piezo Tube Indicator)

By J. Kluge and H. E. Linckh. [G-1]

The Inhibitory Action of Various Substances on the Deterioration of Olefinic Fuel Spirits During Storage

By E. W. J. Mardles. [G-1]

Gasoline Inhibitors

By Gustav Egloff, Jacque C. Morrell, C. D. Lowry, Jr., and C. G. Dryer. [G-1]

A Significant Method for the Determination of Gum in Gasoline

By O. C. Bridgeman. [G-1]

The Possibility of the Determination of Potential Gum in Gasoline by Ultra Violet Rays

By M. Freund. [G-1]

The Estimation of the Potential Gum Content of Cracked Gasolines

By W. H. Thomas. [G-1]

Significance of Test Methods for Gums in Gasoline

By Gustav Egloff, Jacque C. Morrell, Charles Wirth, III, and George B. Murphy. [G-1]

The Measurement of Injection-Engine Fuel Ignition Properties

By A. W. Pope. [G-1]

The Desirable Characteristics of Fuels for High-Speed Compression-Ignition Engines

By J. Kewley. [G-1]

The Ignition Quality of Fuels for Compression-Ignition Engines, and Proposals for its Determination

By R. Stansfield. [G-1]

Measurement of Ignition Qualities of Diesel Fuels

By A. E. Becker and H. R. Stacey. [G-1]

Status of Diesel Fuel Oil Standardization in the United States

By P. H. Schweitzer, H. C. Dickinson and M. J. Reed [G-1]

Substitute Diesel Fuels

By Donald A. Howes. [G-1]

The State of Development in Germany of the Power Alcohol Question

By Dr. Fritzweiler and K. R. Dietrich. [G-1]

Portable Producer Plants

By J. Russel. [G-1]

The Polymerization of Gaseous Olefines as a Source of Liquid Fuels

By A. R. Bowen and A. W. Nash. [G-1]

Low-Temperature Carbonization

By J. G. King. [G-1]

Some Notes on Methods for Determining the Cloud Points of Dark Oils

By C. G. Verver. [G-1]

An Analytical Steam Distillation for Measuring the Volatility Range of Lubricating Oils and Other High-Boiling Petroleum Fractions

By R. N. J. Saal and C. G. Verver. [G-1]

Determination of Dilution of Used Diesel Engine Lubricating Oil

By A. R. Stark. [G-1]

Determination of Dilution of Used Diesel Engine Lubricating Oil

By A. R. Stark. [G-1]

Dilution of Diesel Engine Lubricating Oil

By A. T. Wilford. [G-1]

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NOTES AND REVIEWS

Continued

MISCELLANEOUS

Elements of Heat-Power Engineering

By William N. Barnard, Frank O. Ellenwood, and Clarence F. Hirshfeld. Published by John Wiley & Sons, Inc., London, Third Edition, 1933. Part II—Steam-Generating Apparatus and Prime Movers, Fuels, Combustion, and Heat Transmission; 871 pp., illustrated. Part III—Auxiliary Equipment, Plant Ensemble, Air Conditioning, and Refrigeration; 1200 pp., illustrated. [H-3]

These volumes represent a complete rewriting of parts II and III of Hirshfeld and Barnard's "Elements of Heat-Power Engineering."

Inland Transportation—Principles and Policies

By Sidney L. Miller. Published by McGraw-Hill Book Co., Inc., New York and London, 1933; 822 pp. [H-3]

The organization and presentation of material in this volume have as their prime purpose aid to those who seek an understanding of the existing transportation situation; and the author expresses the hope that it may furnish helpful guidance to thought and to constructive action.

Part I states briefly the scope of the book and indicates the general character of transportation prior to the appearance of the railway a century ago. Part II sketches the spectacular development of the American railway net and traces the growth of public regulation. In Part III the services of the railway are described briefly and appropriate reference is made in the course of this discussion to competitive agencies and to their relation to railway service. Because the economic characteristics of the transportation business are so generally misunderstood or ignored, Part IV is given largely to an analysis of public policies actual and proposed. Part V discusses the newer forms of transport at considerable length: a factual presentation concerning each is followed by an analysis of the problems pressing for solution, and a statement is made of what the author believes to be an appropriate public policy with respect to each.

MOTOR-TRUCK

Les Véhicules de Transport Industrial sur Route en 1933

By C. Martinot-Lagarde. Published in *La Technique Moderne*, Oct. 1, p. 633 and Oct. 15, 1933, p. 665. [K-1]

The variety of fuels used, the generalization of the Diesel engine and the inclusion of refinements formerly restricted to passenger-cars are emphasized in this analysis of motor-truck design based on the exhibits at the 1933 Paris automobile show. The principal products of about a dozen French firms are described.

PASSENGER CAR

Le Salon de 1933

By C. Faroux. Published in *La Vie Automobile*, Sept. 25, 1933, p. 337. [L-1]

Radical progress in controls, manouverability and external form is said to characterize the exhibits of the 1933 Salon at Paris. Ten improvements used previously only to a limited extent but now become general are cited as well as four recently introducd design features of great promise. Five novelties of more limited usage are mentioned. Other articles dealing with show developments review automatic controls and streamlining.

La Sécurité et la Construction des Voitures Automobiles

By Henri Petit. Published in *La Vie Automobile*, Oct. 10, 1933, p. 527. [L-1]

After reviewing automotive design features as they bear on safety the author recommends the restriction of the speed of vehicles to the highest at which roadability is assured, greater accuracy and durability in steering systems, brakes of more even action and ease of adjustment and more accessibility in parts requiring service.

Voitures Aérodynamic

By P. Mauboussin. Published in *L'Aéronautique*, November, 1933, p. 239. [L-1]

In streamlining the Chenard and Walcker "Mistral" the author and designer is said to have disregarded the superficial expedients customarily included under the term and evolved a body conforming to fundamental aerodynamic theory, and possessing three original features.

(*Concluded on page 74*)

What Members Are Doing

Austin M. Wolf, author of "1934 Marks Turn from Conventional in Automobile Design" in the January issue of the S.A.E. JOURNAL, described "Automotive Developments for 1934" at the Feb. 5 meeting of the Technology Club of Syracuse (New York) with which the Syracuse Section of the Society is affiliated. The talk was sponsored by the Automotive Service Association of Syracuse, and it was Mr. Wolf's second appearance before the organization.

Austin M. Wolf

Mr. Wolf also spoke before the Montclair Engineering Society on Feb. 2 and the Albany Society of Engineers on Feb. 20.

Leslie Peat has joined the American Standards Association, New York, as editor of *Industrial Standardization.*

Ralph N. DuBois, former assistant chief engineer, Continental Aircraft Engine Co., has joined the Lycoming Mfg. Co., Williamsport, Pa., as engineer in charge of aircraft experimental work. While a member of the Detroit Section Mr. DuBois was editor of the *Supercharger,* its monthly publication.

Chris J. Fields has joined the Servel Corp., Evansville, Ind., as commercial-body layout man. He was with the Auburn Automobile Co.

Benjamin Jerome has been appointed Oldsmobile dealer for the Pontiac, Mich., territory.

Alpheus Flower has formed Flower's International Patents, Ltd., as automobile, aeronautical, consulting and research engineers. The head office is in London.

William W. Harris is patent attorney with the Chrysler Corp., Detroit. He formerly was with the Continental Motors Corp.

Garland Powell Peed, Jr., is engineer with the Waco Aircraft Co., Troy, Ohio.

Laurance F. Magness has resigned as treasurer of the Baltimore Section.

Robert C. Hall, vice-chairman of the Baltimore Section, will act as treasurer for the remainder of the year.

Joseph C. Gorey has been appointed special representative to manage sales of Ross replacement steering-gears in the Eastern states. His address will be Room 1305, 1440 Broadway, New York City.

A. K. Brumbaugh, vice-president of the Society, representing the Truck, Bus and Railcar Activity, has resigned his position as commercial engineer with the White Co., Cleveland. He is making the Cleveland Club his headquarters.

Mr. Brumbaugh was formerly vice-president of the Society, representing the Production Activity. He has been a member since 1916.

G. M. Bellanca, president, Bellanca Aircraft Corp., was elected secretary of the Aeronautical Chamber of Commerce of America, Inc., on Jan. 25.

Charles M. Lawrance, president, Lawrance Engineering & Research Corp., was elected treasurer.

Other members of the Society who received positions on the governing board of the Chamber were:

E. E. Aldrin, manager, aviation department, Standard Oil Co. of N. Y.

Clayton J. Brukner, president, Waco Aircraft Co.

Sherman M. Fairchild, president, Fairchild Aviation Corp.

Philip G. Johnson, president, United Aircraft & Transport, Inc., New York.

Charles Marcus, president, Eclipse Aviation Corp.

Harold F. Pitcairn, Autogiro Co. of America, Inc.

Lester D. Seymour, president, American Airways.

Guy W. Vaughan, president, Wright Aeronautical Corp.

Messrs. Brukner, Lawrance and Seymour were named to the executive committee of the Chamber.

Bjarne Thulin, formerly experimental engineer in the tractor works of the International Harvester Co., Chicago, has resigned to develop an oil engine of his own design in the automotive engineering laboratories of Purdue University, Lafayette, Ind.

Wide World Photo

Edward V. Rickenbacker keeps his hand in the game which made him famous in the World War. Recent cancellation of air-mail contracts flown by private operators was effective Feb. 19. Captain Rickenbacker (M '28) brought the last sack of privately-flown mail from Los Angeles to Newark Airport in 13 hr., 4.20 min., setting a new West-East record for air-transport operations.

Arthur J. Aiers is works superintendent for the Sunbeam Motor Co., Wolverhampton, England. He was production manager for Riley (Coventry), Ltd.

Ing. Aldo Piselli is technical adviser on aviation engines for Isotta Fraschini, Milan, Italy. He was general manager for Fenwick, S.A., Milan.

James Hartness

James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vt., and an ex-governor of the state, died Feb. 2 at the age of 72. He has been a member of the Society since 1917 and served in 1918 as a member of the House Committee.

Mr. Hartness had a distinguished career in his profession and in the public service. His

James Hartness

interests ranged from astronomy to ordnance and aviation. His private laboratory included perhaps the most elaborate privately-owned astronomical equipment in the United States.

James W. Cottrell

James W. Cottrell, technical editor of the *Commercial Car Journal,* died Feb. 15, after an illness which had lasted some time. He was widely known in the transportation and maintenance field and had been a member of the Society since 1929.

Mr. Cottrell began writing for technical journals in 1919, after war service with the Ordnance Motor Instruction Corps. In 1926 he became technical editor of *Operation & Maintenance* which was later merged with the *Commercial Car Journal,* Mr. Cottrell continuing as technical editor of the combined publications.

On joining the Society he took an active part in Philadelphia Section affairs. In 1931 he became a member of the Transportation and Maintenance Activity Committee and has served on it since that time.

Z. D. Granville

Z. D. Granville, designer of prize-winning racing airplanes, was fatally injured Feb. 12 when a sports model he was flying crashed from a low altitude above the Spartanburg, S. C., Memorial Airport.

Mr. Granville had joined the Society within the past year. He was a partner in Granville, Miller and De Lackner, consulting engineers on aircraft design.

C. T. Klug

C. T. Klug, sales manager of the Willard Storage Battery Co., Cleveland, died Jan. 27 after an extended illness.

Mr. Klug had been a member of the Society since 1917 and was an active participant in Cleveland Section affairs. From 1921 to 1925 he was a member of the Storage Battery Division of the Standards Committee and in 1926 became chairman of the Division.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Jan. 10, 1934, and Feb. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ANDERSON, EMIL (M) vice-president, Anderson Transmission Co., Briarcliff Manor, N. Y.; (mail) 1907 Park Avenue, New York City.

BLONDE, J. CARL (A) service department engineer, Bendix-Eclipse of Canada, Ltd., Walkerville, Ontario, Canada.

COBHAM, ARTHUR H. (A) vice-president, Gotfredson Trucks, Ltd., 242 Spadina Ave., Toronto, Ontario, Canada.

COLLOM, S. H., JR. (A) consulting engineer, Pennsylvania Flexible Metallic Tubing Co., 72nd Street and Powers Lane, Philadelphia.

DHONAU, HERMAN BRUCE (M) engine designer, S. R. Dresser Mfg. Co., Bradford, Pa.; (mail) 86 School Street.

DOUGLAS, MALCOLM L. (A) general sales manager, Dominion Rubber Co., Ltd., Kitchener, Ontario, Canada; (mail) 53 Fairview Avenue.

EVANS, GEORGE DORSEY (J) supervising engineer, Municipal Airport, Ann Arbor, Mich.; (mail) 613 Packard Street.

FREEMAN, EDWIN W. (A) superintendent of operations, Cities Service Oil Co., Ltd., Toronto, Ontario, Canada; (mail) 1179 Yonge Street.

GOLDSCHMIDT, MAX (F M) president, Mecano, G.M.B.H., Frankfort-a-Main, Germany.

GRAHAM, PAUL FRANCIS (J) electrician, Albert H. Smith Co., 33 Shattuck Street, Lowell, Mass.; (mail) 83 Newhall Street.

HANNUM, CHARLES MARTIN (J) assistant to manager, Canyon Placers, Inc., Dedrick, Trinity County, Calif.

HARDIE, NELSON A. (A) vice-president, McQuay Norris Mfg. Co. of Canada, Ltd., Toronto, Ontario, Canada; (mail) Box 635, Toronto 9, Ontario, Canada.

HOLSTEIN, I. M. (J) 45 Hobson Street, East Haven, Conn.

HOLTZKEMPER, EDWARD H. (J) laboratory assistant, Chevrolet Motor Co., 2117 Holbrook Avenue, Detroit.

HUNTER, ROBERT H. (A) vice-president, superintendent, Johnson Bus Lines, Inc., 34 Main Street, Milford, Mass.; (mail) Bellingham, Mass.

IRWIN, THOMAS H. (A) manager, T. Eaton Co., Ltd., Toronto, Ontario, Canada; (mail) 32 Rivercrest Road, Toronto 9, Ontario, Canada.

JAGEMANN, GEORGE N. (M) general superintendent, Eastman Mfg. Co., 1002 North 11th Street, Manitowoc, Wis.

JOHNS, DONALD CHARLES (A) supervisor, automotive oil sales, Gulf Refining Co., 1515 Locust Street, Philadelphia.

KANDA, M., MAJOR (M) inspector for aviation, Imperial Japanese Army, 1775 Broadway, New York City.

MEYER, WILBURN E. (M) supervisor of equipment, City of Cincinnati, Highway Maintenance Division, Cincinnati, Ohio; (mail) 520 Fortune Avenue.

POOS, WILLIAM L. (A) sales engineer, Cleveland Graphite Bronze Co., Cleveland; (mail) 7-169 General Motors Building, Detroit.

SCHLINK, FREDERICK JOHN (M) president, technical director, Consumers' Research, Inc., Washington, N. J.

SEARS, M. (A) sales manager, Prismatic Plug Corp. of America, 14-16 Dunham Place, Brooklyn, N. Y.; (mail) 965 Tiffany Street, New York City.

SIMPSON, JAMES I. (A) vice-president, general manager, Dunlop Tire & Rubber Goods Co., Ltd., Toronto, Ontario, Canada; (mail) 870 Queen Street, East.

SPICER, DONALD H. (J) research engineer, Johns-Manville Corp., Manville, N. J.; (mail) 300 West Seventh Street, Plainfield, N. J.

THICKENS, RICHARD (J) student, University of Southern California, Los Angeles; (mail) 1230 Sixth Avenue, Laurel, Miss.

THOMPSON, WILLIAM TULLOCH (J) student engineer, Chrysler Corp., Highland Park Plant, Detroit (mail) 49 Highland Avenue, Highland Park, Mich.

WALSH, JOHN H. (M) superintendent, rolling stock and shops, Middlesex & Boston Street Railway Co., 1040 Main Street, Waltham, Mass.

Applications Received

The applications for membership received between Jan. 15, 1934, and Feb. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ALBERTSON, SCOTT M., manufacturers representative, Andrews-Albertson Co., Detroit.

BAMPTON, CYRIL CHARLES, chief transport superintendent, Iraq Petroleum Co. Ltd., Haifa, Palestine.

BUCHANAN, WALTER I., engineer, Perfection Gear Co., Harvey, Ill.

CLOUTIER, E. J., chief body engineer, Graham-Paige Motors Corp., Detroit.

DODT, ELMER C., chief draftsman, Chrysler Motor Corp., Highland Park, Mich.

FAULKNER, FRED L., automotive engineer, Armour & Co., Chicago.

FREEMAN, WALTER R., automotive engineer, Wagner Electric Corp., St. Louis, Mo.

GARDENER, ALLEN F., sales engineer, The Chicago Rawhide Mfg. Co., Chicago.

GILBERT, GROVER D., motor vehicle supervisor, Illinois Bell Telephone Co., Chicago.

GILBERT, LEONARD BECK, National account salesman, The White Co., Chicago.

GIVENS, ED. S., manager-owner, Givens Products Co., Kansas City, Mo.

GODDARD, PAUL B., factory manager, Universal Products Co., Dearborn, Mich.

GRABLE, EDWARD, shop foreman, Auto Electric Service Co., Brooklyn, N. Y.

GROMER, GEORGE N., supervisor of motor vehicles, The Mountain States Tel. & Tel. Co., Denver, Colo.

HAHN, WILLIAM PERRY, member of firm, Hood & Hahn, Indianapolis, Ind.

HARRISON, R. L., president, R. L. Harrison Co. Inc., Albuquerque, N. M.

HAYWARD, HENRY FRANCIS, works manager, York Motors, Sydney, Australia.

HUTCHESON, CAPT. JOHN C., motor transport, Quartermasters Corps, Fort Sill, Okla.

LANGE, A. R., technical director, Swan Finch Oil Corp., New York City.

LEIGHTON, JOHN W., president, Pressed Metals of America, Inc., Port Huron, Mich.

MCCOMBS, STUART C., vice-president in charge of oil seals, sales and production, The Chicago Rawhide Manufacturing Co., Detroit.

MELIN, STEN S., engineer, experimental division, Midland Steel Products Inc., Cleveland.

MENZEL, H. F., owner, Indianapolis Pattern Works, Indianapolis, Ind.

MEYER, THEODORE F. W., manager, propeller division, Federal-Mogul Corp., Detroit.

MORSE, HOWARD H., service superintendent, Tracey & Co., Inc., Portland, Oregon.

MOUNT, WILBUR S., automotive engineer, Socony-Vacuum Corp., New York City.

MYERS, RAYMOND, service manager, Lafayette Motor Sales Inc., Suffern, N. Y.

PRUTTON, C. F., associate professor of chemical engineering, Case School of Applied Science, Cleveland.

RODERT, LEWIS A., instructor, Duluth Junior College, Duluth, Minn.

RODGERS, GEORGE C., test engineer, Wright Aeronautical Corp., Paterson, N. J.

ROTH, FRANK, owner, Boro Valve & Brake Service, Bronx, N. Y.

RUMFORD, GEORGE, operating manager, Chrysler Motors Corp., Detroit.

RUTH, JOSEPH P., president and general manager, The Ruth Co., Denver, Colo.

STEWART, CLIFFORD RICHARD, manager and co-partner, Faber Petroleum Inspection Service, San Francisco.

TAINISH, HENRY MCNEIL, consulting engineer, 50 Wells St., Toronto, Ont., Canada.

UTLEY, UHL F., experimental engineer, Dodge Brothers Corp., Detroit.

VANN, WILLIAM H., chief inspector, Pontiac Motor Co., Pontiac, Mich.

WATTS, CHARLES FRANCIS, mechanic, service, Curtiss-Wright Airplane Co., St. Louis, Mo.

WEBB, KENNETH E., student, Case Technical High School, Detroit.

WHITE, CHARLES O., field representative, Ethyl Gasoline Corp., Los Angeles.

WRIGHT, HENRY THOMAS, manager, H. Wright Transport, Lambton Mills, Ont., Canada.

ZARO, NICHOLAS J., production manager, General Motors Peninsular S.A., Barcelona, Spain.

2nd Engineering Display Success

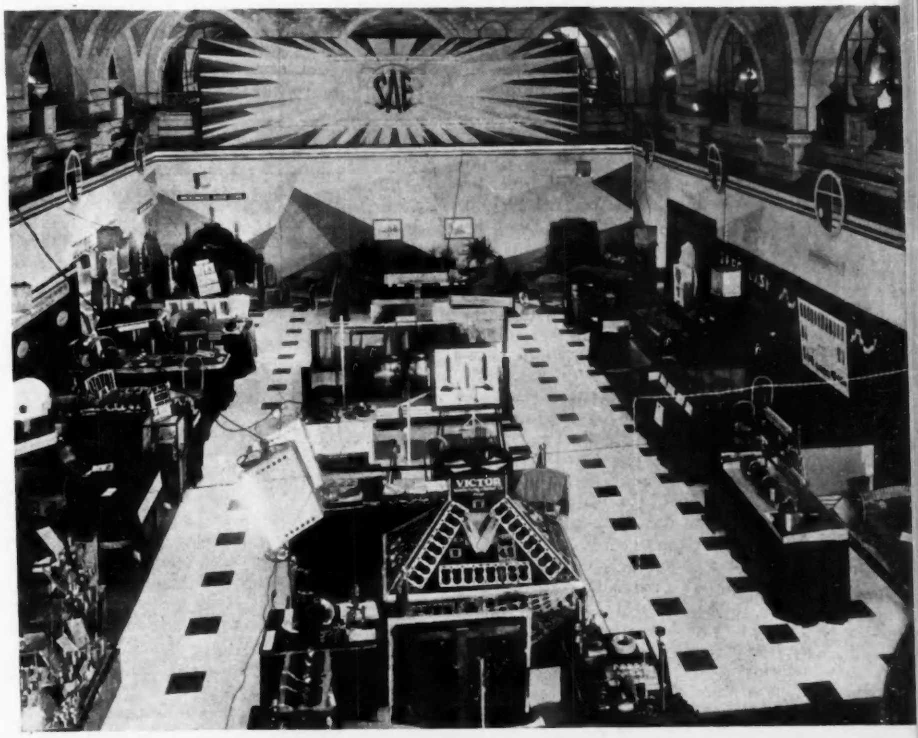
List of Exhibitors

Aluminum Co. of America
American Cable Co.
American Chemical Paint Co.
Bunting Brass & Bronze Co.
Campbell, Wyant and Cannon Foundry Co.
Carnegie Steel Co.
Cermak Westinghouse Lamp Co.
Cleveland Graphite Bronze Co.
Continental-Diamond Fibre Co.
Detroit Edison Co.
Henry L. Doherty & Co.
The Dole Valve Co.
Electric Autolite Co.
Federal Mogul Corp.
Gemmer Mfg. Co.
General Electric Co.
The Globe Machine & Stamping Co.
Hercules Motors Corp.
The International Nickel Co., Inc.
Micromatic Hone Corp.
Monroe Auto Equipment Co.
The Perfect Circle Co.
Thomas Prosser & Son
R. C. A. Victor Co., Inc.
Rivett Lathe & Grinder Corp.
The Skinner Chuck Co.
Spicer Manufacturing Corp.
Stromberg-Carlson Telephone Mfg. Co.
Trico Products Corp.
Tubular Rivet & Stud Co.
United American Bosch Corp.
Victor Manufacturing & Gasket Co.
Waukesha Motor Co.
Wilcox-Rich Corp.

Engineers met engineers at the special engineering exhibits displayed in connection with the 1934 S.A.E. Annual Meeting.

Immediately below is pictured a part of the main display room which housed over half the exhibits.

The bottom picture shows the historical panorama set-up at the rear of the main meeting room.



News of the Sections

- Keeps Planes Attitude
- Proper Shape for Combustion
- The Truth Without Alloy
- Nine Speakers on Trucks

Independent Springing Considered At Three Section Meetings in Month

- St. Louis
- Chicago
- Buffalo

VARIOUS phases of the independent front-wheel suspension problem were treated at St. Louis Jan. 17, at Chicago Feb. 6 and at Buffalo Feb. 7.

Over 250 members and guests of the St. Louis Section heard Willard Haight, engineer, Buick Motor Co. After reviewing the engineering changes in the Buick chassis resulting from the adoption of independent front-wheel springing, Mr. Haight turned to the metallurgical problems of the springs themselves.

Since no manufacturer was found willing to produce the springs required for the front end suspension within the tolerances required, Buick has had to manufacture its own spring requirements. The spring material used is manganese steel, S.A.E. No. 9260. Life of these springs is predicted to be from four to six times that of an equivalent leaf spring.

Manufacturing process consists of first centerless grinding the stock to size. Both ends of the piece are then heated for a distance of about one foot and flat bearing surfaces produced at each end. The bar is then heated to 1560 deg. fahr. in a neutral atmosphere furnace which prevents the formation of scale. No change in surface analysis takes place, an important consideration since maximum stress occurs on the surface.

Removed from the furnace the spring is coiled on a mandrel. After forming it is reheated for hardening—being held at 1610 deg. fahr. for 45 min. At the end of the heating it is oil quenched after being placed in a fixture, in the bath the oil fed to the inside of the spring thereby quenching the inside portion of the coils first. The oil bath is maintained at a temperature of 100 deg. fahr. Springs are immersed 75 sec. Following removal from the oil bath, the spring enters the tempering oven where it stays for 90 min. at 875 deg. fahr. Removed from the oven it is quenched in cold water.

Following this procedure springs are inspected for hardness and must fall within close limits, which are set for a Brinell diameter of impression of 0.280 to 0.300.

The spring is then held in an automatic fixture at right angles to the faces of two grinding wheels. Both ends are ground simultaneously. After grinding, each spring is completely compressed. It is then allowed to go free and its height measured. This height must fall within very close limits. As a final check, the spring is compressed by a load equal to that it must support in the car and its height measured.

Springs are then rustproofed. This process involves washing with hot water then with cold after which they enter the bonderizing or rustproofing bath. After drying springs are dipped in enamel and baked thereby producing a durable elastic finish.

At Chicago, Maurice Olley, special problems engineer, Cadillac Motor Car Co., presented his paper which he had read at the Annual Meeting, on "Independent Wheel Suspension and Associated Problems." Mr. Olley's paper is printed in full elsewhere in this issue. The paper was heard by 216 persons at Chicago.

More than 120 members and guests were present at the Buffalo meeting. William J. Davidson, General Motors Corp., was the principal speaker.

In the absence of Fred Cornell, chairman of the Buffalo Section, Karl M. Wise, vice-chairman, presided at the meeting.

Mr. Davidson's talk was highly entertaining and a great deal of added interest was injected into the program through the use of sound motion-pictures and illustrated slides. During the discussion, the speaker reviewed the history of the development of independent spring suspension by General Motors, dwelling upon the engineering objectives for which they were striving, and explaining in detail how these objectives were eventually obtained.

At the conclusion there was a round table discussion during which Mr. Davidson answered scores of questions. This impromptu discussion, lasting more than an hour and a half, proved very enlightening.

Prior to the meeting Mr. Davidson was a guest of the Buffalo Section officers at a dinner at the Statler.

Lubricant Testing Discussed by Moore

- So. California

Under the broad subject of "Modern Methods of Evaluating Lubricating Oil", C. C. Moore, Jr., research supervisor, Union Oil Co. of California, described at the meeting of the Southern California Section on Jan. 12, some of the more recently developed methods of test and their significance as related to service in an automobile engine. The speaker stated that he had found the Indiana (Rogers) Oxidation Test to be the most satisfactory for predicting the stability or oxidation resistance of an oil in service, whereas some of the older methods of test, such as the Sligh test, apparently did not give good correlation.

The method used to determine lubricating value of a motor oil, or the ability of the oil to prevent engine wear, was also discussed. This method consists in determining the iron content of the used lubricating oil at different periods throughout the test run, which is equivalent to 500 miles of operating under normal driving conditions. The speaker stated that very interesting and significant results can be obtained, provided extreme care is taken in the cleaning and preparation of the engine, and in the method of sampling the used oil.

The speaker explained the method by which high viscosity-index and high-oxidation-resistance oils can be obtained by means of latest developments in the solvent extraction process from selected California crudes. Data were submitted indicating that oils produced from waxy California crudes by solvent refining and propane dewaxing had viscosity-temperature slopes similar to typical eastern oils of the same S.A.E. grade and, when tested by the Indiana Oxidation Test, markedly superior oxidation resistance to the usual eastern or western lubricating oils of the same viscosity grade.

The relationship of flash-point to oil consumption in service was also discussed, and Mr. Moore gave it as his opinion that the general relative position of the flash point could be taken as an indication of average volatility and of the relative consumption of different oils under carefully controlled service conditions, but that fine differences, such as 20 or 30 deg. fahr. had no significance.

E. Favary, F. C. Patton, and others joined in a general discussion of some of the points raised.

Power to Weight Ratio Analyzed by Badertscher

- Dayton

D. K. Badertscher, designing engineer, Hudson Motor Car Co., Detroit, read a paper on "Power to Weight Ratio and Car Performance" at the Jan. 16 meeting of the Dayton Section, which was open jointly to members of the Engineers Club.

Mr. Badertscher's paper dealt chiefly with the development of the Terraplane as a car with high-speed and high-acceleration performance.

Development of a special single-cylinder engine in which the brake mean-effective-pressure was raised from normal-value ranges to 579 lb. per sq. in. was described at the Feb. 14 meeting of the Dayton Section by Ford L. Prescott, senior mechanical engineer, U. S. Army Air Corps materiel division, Wright Field. Mr. Prescott's topic was "New Developments in Aircraft Engines".

J. A. Roché of Wright Field talked on "New Developments in Aircraft" and R. K. Stout of Wright Field talked on "Aids to Navigation". Attendance at the meeting was 65.

Cites Importance Of Obsolescence

• Oregon

The obsolescence factor in motor-vehicle operation becomes increasingly important with the development of vehicles having a high ratio of payload to gross weight, according to Harley W. Drake, superintendent of garage, Portland Gas & Coke Co., who spoke at the Jan. 12 meeting of the Oregon Section.

N. R. Craig, United Air Lines, spoke at the same meeting on "Progress of Air Transportation".

The fleet operator's first problem is an analysis of his transportation needs, Mr. Drake pointed out. The more costly errors in operating are probably experienced at this stage, he said, although truck manufacturers have been trying for years to assist the operator in this respect.

Several types of depreciation methods were discussed and the opinion advanced that no single method was perfect in every respect. Particular attention should be given to gasoline consumption in choosing a vehicle for a specific job, Mr. Drake said.

"THE Gyroscope and Its Use in Navigation of Air and Water Craft" was the subject at the Feb. 9 meeting of the Oregon Section. H. S. Burtis of the Sperry Gyroscope Co., handled it comprehensively.

Special attention was given to application of the gyro principle and instruments in aviation with recent developments in pilots for automatic flying.

Mr. Burtis demonstrated the principles of the gyroscope and gyro-compass, giving a history of its development and use in seacraft, and then dwelling on its application in aircraft.

When the pilot can see where he is going, there is no use for such instruments, but if the view is cut off, his sense of direction is gone and he is "flying blind". Then it is impossible to fly a given course, the speaker stated. This led to invention and use of the artificial horizon and directional gyro, now on every Army and Navy plane and widely used in all aircraft, continued the speaker. Dials show what the plane does in relation to the earth and indicate how to keep the plane in proper attitude. A graduated card on the gyroscope shows if the plane goes off the course even slightly. These two instruments are combined into the instrument that automatically steers a plane and holds it on even keel. The gyro-pilot makes work much easier on the human pilot, giving him time for proper navigation of the ship, radio readings and in event of a forced landing, concentrated attention can be given to that emergency.

"Each job is custom built", said Mr. Burtis. "There is careful engineering to meet or fit the exact need in every installation. Only the surface has been scratched as to possibilities, and much improvement will be noted in the coming years. A gyro-pilot for airplanes is a possibility, with new sensitiveness. Even now it is possible for a plane to take off the ground, reach a certain altitude, hold it, and also hold a set-direction, by means of these instruments. The gyro-pilot made possible the flight around the world of Wiley Post. He had very little clear weather and admits that success would have been impossible without the robot pilot."

The gyroscopic method, he declared, affords the only practical method of obtaining a fixed reference. Said he: "The gyroscope is unaffected by external forces caused by turbulent air or motion of the airplane, and supplies a constant reference to the earth, from which any deviation of the airplane can be detected. Immediate correction is obtained by the use of servo motors which supply the power for moving the controls.

"As soon as the plane has gained the required altitude, the automatic pilot is connected and immediately takes over the three controls. Lateral and longitudinal stability is maintained by automatic control of the ailerons and elevator, an adjustment being provided for trimming the ship for any condition of load. Changes of course may be made as desired by means of a course adjusting knob. Maneuvers such as flat or banked turns or glides may be made with precision through use of the pilot. Whenever it is desired to take over the controls, this pilot may be instantly disconnected by the movement of a single lever.

"An engine-driven air pump supplies the air for spinning the gyros and also for the air pick-off and air-valve system. An engine-driven oil pump delivering 3 gal. per min. at 25 to 200 lb. pressure, as required, provides the power to the pistons for moving the controls. The action of the hydraulic servo units is such that a large amount of corrective control is given quickly for a large departure from the course. There is no continuous oscillation, and in smooth air the controls will remain almost stationary for considerable periods of time. A by-pass valve engages or disengages the automatic control."

O.S.U. Branch Hears Grow

Major Robert W. Grow, U. S. A., was the speaker at the Jan. 12 meeting of the Ohio State University Student Branch. Major Grow is executive officer of the First Cavalry (Mechanized) Regiment. He described the objectives of the Army in its motorization and mechanization plans to an audience of 150 who attended the meeting.

Meetings on New-Car Topics Draw Attendance Near 800

• Indiana
• Milwaukee
• So. California
• Washington
• New England

GENERAL advances in the engineering of 1934 automobiles as a topic filled five section programs during the month. At the Indiana Section Meeting Feb. 8, D. G. Roos, chief engineer, Studebaker Corp., and president of the Society, gave a review of the automobile shows from the engineering side.

Herbert Chase, consulting engineer, New York, presented "Highlights of the Shows and the S.A.E. Annual Meeting" at the Feb. 7 meeting of the Milwaukee Section.

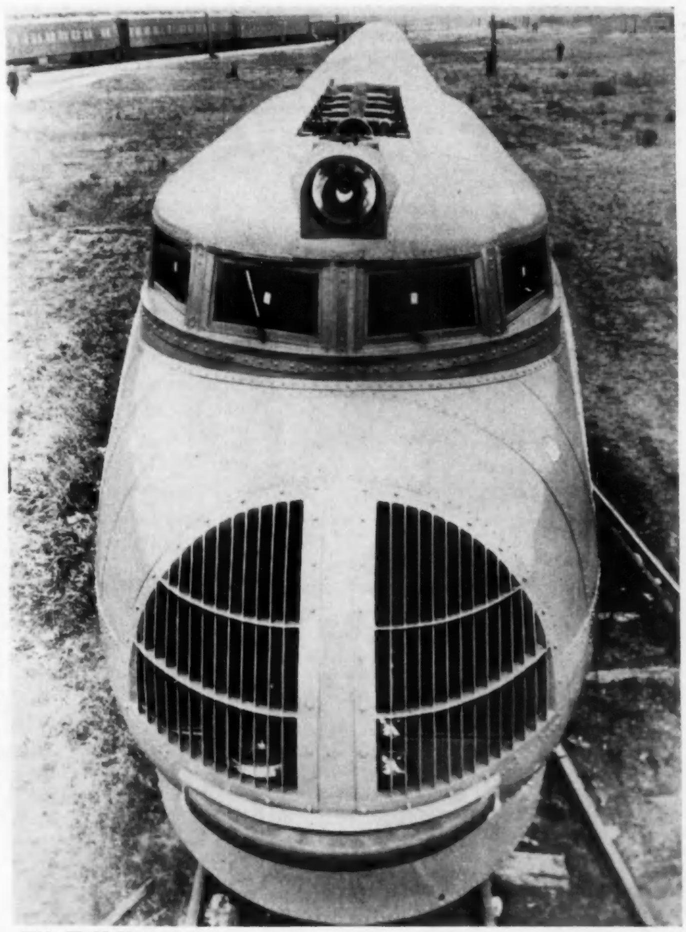
The Feb. 9 meeting of the Southern California Section heard Ethelbert Favary, consulting automotive engineer, Los Angeles, on "The Latest Developments in Automotive Construction as Disclosed in 1934 Models". The Southern California meeting was held jointly with Automotive Boosters Club No. 20.

Clarence S. Bruce, Bureau of Standards, covered the engineering features of 1934 cars at the January meeting of the Washington Section.

On the Feb. 13 program of the New England Section Prof. Dean A. Fales, automotive engineering department, Massachusetts Institute of Technology, spoke on "Novel Features of the New Models".

Large attendance turned out at each of the meetings mentioned. At Milwaukee, 50 heard Mr. Chase; at Washington, 75 were present for the meeting; 215 heard Mr. Roos at Indianapolis; and 225 attended the New England meeting.

At right is the Union Pacific streamlined train recently put into transcontinental service. It is designed to "cruise" at 90 m.p.h. and to have a top speed of 110 m.p.h. Hubert Walker, chief engineer, American-LaFrance & Foamite Corp., described such developments to a meeting of the Technology Club of Syracuse Feb. 19. The meeting was sponsored by the Syracuse Section of the Society. The train is said to weigh 160,000 lb. It has a Diesel-electric drive and will accommodate 116 passengers. Three similar trains of larger capacity have been ordered by Union Pacific from the Pullman Co.



Wide World Photo

Bull Presents Tire-Noise Paper

• Cleveland

Dr. A. W. Bull, research division, United States Rubber Co., gave his paper on "Tire Noise" at the Feb. 21 meeting of the Canadian Section. Dr. Sidney M. Cadwell, director development division, tire department, U. S. Tire Co., Inc., was present at the meeting.

Combustion Chambers Reviewed by Jardine

• Cleveland

"Aluminum Combustion Chambers" was the topic presented at the Feb. 12 meeting of the Cleveland Section. The speaker was Frank Jardine, chief engineer, castings division, Aluminum Co. of America. Mr. Jardine told of the development of aluminum-alloy cylinder heads and the characteristics of various combustion chambers. Members and guests of the Section numbered 130 at the meeting. Discussers were many, including A. T. Colwell, T. S. Kemble, Ferdinand Jehle, W. S. Howard, A. O. Willey and A. J. Scaife.

"Naked Truth" Told At Unreported Meeting

• Philadelphia

The Philadelphia Section held its annual "naked truth" meeting Feb. 14 with John A. C. Warner, general manager of the Society in the chair. Speakers are encouraged to tell all, with the proviso that they will not be reported in print.

The speakers at the session were Walter Graf, Edward G. Budd Mfg. Co.; Joseph Geschelin and W. K. Toboldt, Chilton Co., and E. B. Neil, N. W. Ayer and Son.

James W. Cottrell, technical editor, *Commercial Car Journal,* one of the leading spirits in the institution of the meeting, was not able to be present because of the illness which later resulted in his death (reported elsewhere in this issue).

Science of Metals Described by Mehl

• Indiana

A paper on "The Science of Metals" was presented at the Jan. 10 meeting of the Indiana Section by R. F. Mehl, director, Bureau of Metallurgical Research, Carnegie Institute, Pittsburgh. Dinner preceding the meeting was attended by 65 persons and the meeting drew a total of 115, being held jointly with the Indianapolis Chapter, American Society for Steel Treating.

Nine Speakers Tell Of Truck Designing

• Metropolitan

The opening of the Feb. 15 meeting of the Metropolitan Section saw a speakers' platform loaded with truck engineering talent. No less than nine leading engineers spoke on the program, which was based on the general topic of "How Truck Engineering Design Reduces Maintenance Costs".

The speakers, in the order of their appearance, were: Frank G. Alborn, chief engineer, White Motor Co., Cleveland; G. Waine Thomas, executive engineer, Reo Motor Car Co., Lansing, Mich.; Merrill C. Horine, sales promotion manager, International Motor Co., New York; A. W. Scarratt, chief engineer motor trucks, International Harvester Co., Chicago; O. K. Kelly, development engineer, General Motors Truck Corp., Pontiac, Mich.; Charles Kynock, Dodge Bros. Corp., Detroit; Alex Taub, development engineer, Chevrolet Motor Co., Detroit; G. H. Scragg, executive, Brockway Motor Co., Inc., New York; and Adolf Gelpke, assistant chief engineer, Autocar Co., Ardmore, Pa.

Walter S. Peper, Section chairman, introduced F. K. Glynn, engineer, operation and maintenance of automotive equipment, American Telephone & Telegraph Co., New York, who conducted the meeting.

Dinner preceding the meeting was attended by 162 members and guests. The meeting itself drew 350, including members of the Automotive Service Association of New York, who had been invited.

Fashion Show For Ladies' Night

• Detroit

A fashion show and plenty of entertainment were scheduled for the "ladies' night" to be held by the Detroit Section, Feb. 21. Dorene, queen of the accordion, who entertained during the Annual Meeting Dinner was booked for a return engagement. Eddie Griffith and his orchestra played for the singers and for dancing. Dinner was at seven, with dancing until one. Stags attending got seats at special front-row tables.

M.I.T. Students Tour

Nineteen members of the Massachusetts Institute of Technology Student Branch of the Society signed up for a mid-year inspection tour beginning Jan. 29. The tour included a variety of automotive plants in New England and New York. While in New York members of the group were entertained at dinner by officers of the Metropolitan Section.

Meetings Calendar

S.A.E. Summer Meeting

Saranac Inn, Saranac Lake, New York, June 17-22, 1934.

Baltimore—March 8

Engineers Club of Baltimore; dinner 6:30 P.M.

Some Aspects of Commercial Aviation—Charles Froesch, general service manager, General Aviation Mfg. Corp.

Canadian—March 21

Royal York Hotel, Toronto; dinner 7:00 P.M.

Review of Piston Ring and Cylinder Development—H. M. Bramberry, engineer, Perfect Circle Co.

Chicago—March 6

Crystal Room, Hotel Sherman; dinner 6:45 P.M.

Past Chairmen's Night—Diesel and Tractor Meeting. Development of Diesel Engines for Industrial and Agricultural Tractors—C. B. Jahnke, research engineer, International Harvester Co.

Economics of Development and Use of Tractors—A. P. Yerkes, Editor, *Tractor Farming.*

Cleveland—March 12

Cleveland Club; dinner 6:30 P.M.

The All-Service Vehicle—Martin Schreiber, general manager in charge of plant, Public Service Coordinated Transport.

Dayton—March 12

Engineers Club; 8:00 P.M.

Joint Meeting with the Dayton Chapter of the American Society for Testing Materials. Speaker—Owen C. Jones, Linde Air Products Co.

Indiana—March 15

The Athenaeum, Indianapolis; dinner 6:30 P.M.

Aviation meeting.

Kansas City—March 9

Steuben Club; dinner 7:00 P.M.

Dinner dance and bridge party.

Metropolitan—March 15

The Roger Smith, 40 E. 41st St., New York; dinner 6:30 P.M.

Spark-Ignition Oil Engines—F.H.Dutcher, mechanical engineering dept., Columbia University; F. C. Mock, research engineer, Bendix Research Corp.; Dr. Maurice J. Zucrow.

Milwaukee—March 7

City Club of Milwaukee; dinner 6:30 P.M.

Indicator Diagram Analysis with Respect to Effective Combustion—J. C. Slonneger, experimental engineer, and Hans Fischer, research and diesel engineer, Falk Corp.

New England—March 13

Eastern Massachusetts St. Railway, Campello Shops, Brockton, Mass.; dinner 6:30 P.M.

Modern Motor Bus Maintenance and Shop Practice—W. C. Bolt, superintendent of rolling stock, Eastern Massachusetts Street Railway.

Philadelphia—March 7

Inquirer Bldg.; dinner 6:30 P.M.

Lubrication, with Special Reference to the Use of Lighter Oils—H. C. Mougey, chief chemist and assistant technical director, General Motors Research Laboratories.

Southern California—March 24

Jonathan Club, Los Angeles; dinner 7:00 P.M.

Eighth annual dinner dance and entertainment.

Washington—March 7

University Club, Washington, D. C.; dinner 6:30 P.M.

Automotive and Railplane Transportation—William B. Stout, president, Stout Engineering Laboratories, Inc.

Discussion by Joseph B. Eastman, Federal Coordinator of Transportation.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Almen, J. O., and Wilson, E. E.
Analysis of Intake Silencer Problems

Barnard, D. P.; Barnard, E. R.; Rogers, T. H.; Shoemaker, B. E.; and Wilkin, R. E.
Causes and Effects of Sludge Formation in Motor Oils

Bleicher, C. E.
External Broaching

Boelter, L., and Rusk, D. O.
The Relation of the Mechanical Construction of Headlamps to Their Performance Upon the Roadway

Bogan, R. A.
Abuses on the Road by Operators

Brettell, Clinton
How Economies in Motor Vehicle Operation Can Be Effected from an Operator's Standpoint

Briggs, Commander W., and Fox, M. L.
Body Noise

Broulhiet, Georges
Quality Objectives for Engineers—An official communication from the Societe des Ingenieurs de l'Automobile de France

Brown, W. C., and Roper, V. J.
The Well-Lighted Car

Bull, A. W.
Tire Noise

Chandler, F. F.
Notes on Steering

DeSmet, E. C.
Planography—The New Science of Surface Design

Falge, R. N.
Modern Headlighting Requirements

Fisher, J. B.
Combustion Problems on Automotive Diesel Engines
Engine Design from Wear and Maintenance Viewpoint

Fisher, J. B., and Bower, L. L.
Trends in Tractor Engine Design

Fitzsimmons, J. T.
Problems and Tendencies in Electrical Equipment

Fodor, Nicholas
Hydraulics of High-Speed Fuel Injection

Foley, Hamilton
Manufacture and Magnetic Inspection of Hollow-Steel Propellers

Frye, Jack
Aircraft Maintenance on Scheduled Service

Gagg, R. F., and Farrar, E. V.
Prediction of Altitude Performance of Aircraft Engines with Gear-Driven Superchargers

Haarz, W. G., Jr.
Beauty Sells Cars in 1934

Hazard, S., Jr.
Sound Absorption and Deadening

Horner, F. C.
Looking Forward in the Field of Transportation

Hunsaker, J. C.
Airships for Commercial Purposes

Jacoby, E. R.
Practical Design Consideration of the Internal Combustion Engine Structure

Johnson, W. M.
A Résumé—and Some Conclusions

Kuttner, Julius, and Rippere, J. B.
Ignition Delay of Diesel Fuels Measured by Bouncing Pin in C.F.R. Engine

Lansing, R. P.
Starters for Diesel Engines

Lichty, L. C., and Carson, G. B.
Engine Friction Analysis

Macauley, J. B.
Fuel Economy from the Engine Designer's Point of View

Marble, J. C.
The Lysholm-Smith Hydraulic Torque Converter

Moss, F. A.
Air Conditioning and Relative Refinements for Auto Bodies

Norris, R. F.
The Automobile Motor Considered as a Sound Source

Nutt, Arthur
Detonation Rating of Aviation Fuels

Orr, J. M.
Predetermined Operating Requirements for Purchasing Equipment

Peterson, C. D.
Multi-Range Transmissions

Prescott, F. L.
High-Output Poppet-Valve Cylinders

Prudden, T. M.
Noise Treatment in the Automobile

Rendel, T. B.
European Automotive Diesels

Robertson, D. D.
Hydraulic Action in Piston Ring Design

Rothrock, A. M.
A Photographic Study of Combustion in a High-Speed Compression-Ignition Engine

Shepard, E. H.
The Economy Fallacy

Smith, C. W.
Comparative Tests of Pneumatic Tires and Steel Wheels on Farm Tractors in Agricultural Operations

Stewart, J. P., and Risk, T. H.
Factors Affecting Oil Consumption

Taub, Alex
Engine Mountings

Teetor, R. R.
Conformity of Cylinders, Pistons and Rings

Treiber, O. D.
Factors in Automotive Diesel Development

Wheatley, J. B.
The Theory of Rotating-Wing Aircraft

White, L. T.
Why Waste Fuel Through the Exhaust?

A $700 Airplane?

(*Continued from page 16*)

A comprehensive summary of several of the design questions to be solved was given by Henry S. Cocklin, aeronautical engineer associated with many Navy plane developments. Part of Mr. Cocklin's discussion follows:

"From a sales angle", he said, "the plane must be in a class so far unknown. Present day 'flivver' planes are waved aside as not suitable. Such planes today are most certainly not 'all metal'. They do not have a close resemblance to the popularly accepted transport of the day. They cannot be regarded with the same satisfaction as the low-priced automobile of the day.

Ewing Y. Mitchell, assistant secretary of Commerce, is ex-officio chairman of a committee appointed through the Aeronautics Branch to study various phases of the problem of producing a light airplane in quantities. The main committee has several divisions as follows:

To Confer with the Aircraft Industry: **Eugene L. Vidal, director of aeronautics, chairman; Edward P. Warner, representing the Society of Automotive Engineers; and Leighton W. Rogers, executive vice-president, Aeronautical Chamber of Commerce, representing the Chamber.**

To Study Details of Plane and Engine: **Col. J. Carroll Cone, representing the National Aeronautic Association, chairman; Dr. George W. Lewis, National Advisory Committee for Aeronautics; and Major C. W. Howard, Army Air Corps.**

To Study the Promotional Phase: **Capt. Alford J. Williams, American Petroleum Institute, chairman; Robert B. Renfro, editor *Sportsman Pilot*; Fred. L. Smith, National Association of Aviation Officials; and Amelia Earhart.**

Technical Committee to Confer with Full Committee: **Luther Harris, special assistant to the director of Aeronautics, chairman; John H. Geisse, chief of the manufacturing inspection service; and Richard C. Gazley, chief of the engineering section.**

"When the question of performance is considered, several serious factors are encountered. Even a comparison of the component parts of the automobile and the airplane sheds its unfavorable shadow on the latter:

The Automobile	*The Airplane*
1. The engine, etc.	1. The engine, etc.
2. The body	2. The body
3. The chassis	3. The landing gear
	4. The wings
	5. The tail surfaces

"Of the first three items—the engine, the body and the landing gear—only the running gear is inherently the more complex on the automobile. There is nothing comparable to the wing and empennage of an airplane required on the land vehicle. These two items alone have been running approximately 35 to 45 per cent of the cost of the airplane. This general comparison is made on the basis of the successful models of all-metal airplanes of the day.

"I have conceded the remote possibility of creating a showroom model of the 'flivver' airplane by using the materials and methods of the automobile. But it is when the question of materials comes up that the difficulty really presents itself.

"Bodies for automobiles are being built for from $20 to $40 completely pressed and assembled. These are made from cheap low-carbon steel. Such material when studied from a strength-weight basis would result in a body from two to three times as heavy as produced for the popular transports of the day.

"A few years ago when biplanes and externally-supported monoplanes were popular, structures were built which resulted in airplanes which carried 60 per cent of their gross in useful load. The present low-wing internally stressed, all-metal body jobs are well designed when they carry 40 per cent of their gross in useful load. And these are made from the best materials known from the weight-strength viewpoint. Only the alloys of aluminum and steel are suitable for the craft under discussion and these have not been successfully manufactured into either airplanes or automobiles by the methods used on the latter.

"The cost of producing wings and bodies of the alloys required have been so many thousand per cent higher than the cost of auto bodies in mild steels that no comparison would be constructive. The aircraft engineer must simplify in order to produce lower-priced goods! Simplification will result in greater weights going into the weight empty.

"If we consider the limit to be two pounds of airplane to one pound of useful load, it will take very little figuring to show that the plane must weigh about 1000 lb. and the gross weight may run to 1500 lb. Since nearly all of the 1000 lb. would be alloy materials, the cost of the material, without any work done upon it, may be of interest. Deduct 200 lb. for engine and accessories. Eight hundred pounds of aluminum alloy bought in 4000-ton lots would cost (in the gages likely to be used) about $360. This is more than half of the selling price for material alone—no engine or propeller, no manufacturing or assembling costs are included; no sales expense or profit have been considered."

The opinions given above in some detail are representative of those indicated present in the minds of many of those who attended the Philadelphia Section meeting at which Mr. Neely's remarks were presented. Many other opinions were advanced on particular phases of the problem. Kern Dodge, former director of public safety in Philadelphia, and an aviation enthusiast of long standing, complimented the National administration on the sponsoring of a sound and constructive idea for the advancement of an industry. There was hearty applause.

From the technical side, sporadic discussion centered on the desirability of the low-wing vs. the high-wing plane from the standpoints of increased visibility in the hands of inexperienced operators and safety in minor crashes.

A well-known engine designer gave it as his considered opinion that engines could be built at a price to be included in the $700 range.

Several designers interested in various types of rotating-wing aircraft offered the possibility that such aircraft might meet the need for higher safety factors considered necessary with a large increase in the number of planes in the air.

The temper of the discussion was such that most of the remarks were offered to illuminate corners of a problem which is necessarily of multiform nature. No single meeting could hope to do more than scratch it.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Nineteenth Annual Report of the National Advisory Committee for Aeronautics, 1933

Administrative Report Without Technical Reports; 35 pp. Price, 10 cents. [A-1]

Strength Tests of Thin-Walled Duralumin Cylinders in Compression

By Eugene E. Lundquist. N.A.C.A. Report No. 473, 1933; 20 pp., illustrated. Price, 10 cents. [A-1]

Wing Pressure Distribution and Rotor-Blade Motion of an Autogiro as Determined in Flight

By John B. Wheatley. N.A.C.A. Report No. 475, 1933; 11 pp., illustrated. Price, 5 cents. [A-1]

Stability of Thin-Walled Tubes under Torsion

By L. H. Donnell. N.A.C.A. Report No. 479, 1933; 24 pp., illustrated. Price, 10 cents. [A-1]

The Effect of Spray Strips on a Model of the P3M-1 Flying-Boat Hull

By John R. Dawson. N.A.C.A. Technical Note No. 482, December, 1933; 7 pp., 12 figs. [A-1]

Charts for Determining the Pitching Moment of Tapered Wings with Sweepback and Twist

By Raymond F. Anderson. N.A.C.A. Technical Note No. 483, December, 1933; 19 pp., 5 figs. [A-1]

A Method of Calculating the Performance of Controllable Propellers with Sample Computations

By Edwin P. Hartman. N.A.C.A. Technical Note No. 484, January, 1934; 24 pp., 15 figs. [A-1]

The Effect of Trim Angle on the Take-Off Performance of a Flying Boat

By James M. Shoemaker and John R. Dawson. N.A.C.A. Technical Note No. 486, January, 1934; 15 pp., 8 figs. [A-1]

Tests of Three Tapered Airfoils Based on the N.A.C.A. 2200, The N.A.C.A.-M1, and The Clark Y Sections

By Raymond F. Anderson. N.A.C.A. Technical Note No. 487, January, 1934; 8 pp., 5 figs. [A-1]

A Complete Tank Test of a Flying-Boat Hull with a Pointed Step—N.A.C.A. Model No. 22

By James M. Shoemaker. N.A.C.A. Technical Note No. 488, February, 1934; 15 pp., 16 figs. [A-1]

Practical Experiences with Lightning Discharges to Airplanes

By Heinrich Koppe. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, No. 21, November 4, 1933. N.A.C.A. Technical Memorandum No. 730, December, 1933; 15 pp., 21 figs. [A-1]

Aerodynamic Principles of the Direct Lifting Propeller

By Martin Schrenk. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, Nos. 15, 16, and 17, August 14, August 28, and September 14, 1933; Verlag von R. Oldenbourg, München und

(*Continued on page 38*)

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Feb. 10, 1934, and March 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

AITKEN, MURRAY (J) draftsman, assistant engineer, Kenworth Motor Truck Corp., Yale and Mercer, Seattle, Wash.; (mail) 3412-61st Avenue, South West.

ALLEN, ERNEST H. (A) owner, manager, Allen Battery Co., 622 North West Flanders Street, Portland, Ore.

CHAPMAN, PERCY H. (A) general manager, Long Mfg. Co., Ltd., 44 Edna Street, East Windsor, Ontario, Canada.

CORLESS, LEE M. (J) laboratory assistant, Chevrolet Motor Co., 2117 Holbrook, Detroit; (mail) 178 Dakota, West.

DRAPER, CHARLES STARK (M) research associate, Massachusetts Institute of Technology, Cambridge, Mass.

EVANS, PERCY C. (A) sales and service, A. Schrader's Son, Inc., 334 King Street, East, Toronto, Ontario, Canada.

FANNING, STEPHEN A. (A) office supervisor, Bendix Eclipse of Canada, Ltd., Argyle Road, Walkerville, Ontario, Canada.

FREEMAN, EDWIN W. (A) superintendent of operations, Cities Service Oil Co., Ltd., Toronto, Ontario, Canada; (mail) 1179 Yonge Street.

FUHRING, GUSTAVE (M) service manager, Metropolitan Distributors, Inc., 501-10th Avenue, New York City; (mail) 38 Lincoln Avenue, Rahway, N. J.

LOURIE, EUGENE JOSEPH (J) junior engineer, Chrysler Corp., Detroit; (mail) 95 Tennyson Avenue, Highland Park, Mich.

MARKLUND, VICTOR R. (A) superintendent of maintenance, Tompkins Bus Corp., 735 Richmond Road, Stapleton, S. I., N. Y.; (mail) 318 Jefferson Boulevard, Annadale, S. I., N. Y.

MATOUSEK, STEPHEN L. (J) experimental engineer, O. & S. Bearing Co., 303 South Livernois, Detroit; (mail) 5135 Lonyo Boulevard.

MCGRAW, WILLIAM E. (M) export engineer, Chrysler Corp., Windsor, Ontario, Canada.

MINGES, A. J. (J) junior engineer, Busch Sulzer Bros. Diesel Engine Co., Second and Utah Street, St. Louis, Mo.; (mail) 4046 Humphrey Street.

MUTCH, KENNETH H. (A) service manager, Wentworth & Irwin, Inc., 3334 North East 44th Avenue, Portland, Ore.

SANDERSON, JAMES R. (A) vice-president, Petroleum Conversion Corp., 90 West Street, New York City.

SELBY, LOGAN FRASER (A) department manager, Ontario Motor League, Toronto, Ontario, Canada.

TEIGELER, WARREN F. (J) technical clerk, W. R. Grace & Co., 7 Hanover Square, New York City.

UPDEGROVE, HENRY T., JR. (J) assistant in aeronautics, New York University, University Heights, New York City; (mail) Box 21, University Heights.

WELLS, EDWARD H., JR. (J) staff manager, motor bus division, Johns-Manville Corp., 22 East 40th Street, New York City; (mail) 51 West 81st Street.

Applications Received

The applications for membership received between Feb. 15, 1934, and March 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ANDERSON, DAVID R., manager automotive division, Berry Brothers, Inc., Detroit.

ANDERSON, MERVIL VICTOR, parts manager, General Motors Truck Co., Chicago.

ATKINSON, JOSEPH HERBERT, department manager, Pittsburgh Plate Glass Co., Detroit.

BEARDSLEY, RAYMOND R., assistant sales manager, Sealed Power Corp., Muskegon, Mich.

BENGE, FRANK H., development engineer, Continental Diamond Fibre Co., Newark, Del.

BERG, SIGVAL MANFORD, sales engineer, Stewart Warner Corp., Detroit.

BLEISTEIN, DR. ING. WALTER S., consulting engineer, 15 Park Row, New York City.

CYPHERS, W. D., assistant general manager of sales, Marathon Oil Co., Tulsa, Okla.

ESPOSITO, PATRICK S., partner and manager, Coastwise, Auto Repair Co., Brooklyn, N. Y.

EVANS, HARRY C., manager, Valvoline Oil Co., Seattle, Wash.

EVISON, SAMUEL J., salesman, Dole Valve Co., Chicago.

HAMER, WILLIAM ROBERTS, service manager, General Motors Peninsular S. A., Barcelona, Spain.

HARTNETT, LAURENCE JOHN, managing director, General Motors Holdens Ltd., Melbourne, Australia.

HENDERSON, CLAUDE LYLE, mechanical engineer, Public Works Department, Perth, Western Australia.

JESSUP, G. CARR, Golf Road, Riverton, N. J.

KNUDSEN, WILLIAM J., executive vice-president, General Motors Corp., Detroit.

LEE, HERBERT, service engineer, The Light Production Co., Ltd., London S. W. 1, England.

MARTIN, CHARLES JAMES, chief engineer, F. Coleman & Sons, Detroit.

MATHIS, EMILE E. C., president, Mathis S. A., Strasbourg-Meinau, France.

MCDUFF, AMOS J., New England Manager, D. A. Stuart & Co., Chicago.

MCREAVY, IRVING S., Detroit representative, Ingersoll Milling Machine Co., Rockford, Ill.

NEWELL, ARTHUR TUCKER, chief engineer, Air Associates, Inc., Garden City, N. Y.

NORRIS, R. F., research engineer, C. F. Burgess Laboratories Inc., Madison, Wis.

PRATT, FRED, sales manager, General Motors Corp., Chicago.

ORMISTON, GERALD, controller of factories, Dunlop Perdriau Rubber Co. Ltd., Melbourne, Australia.

ROSSNER, EMERY, mechanical engineer, International Motor Co., Allentown, Pa.

SHOCKEY, ELI G., consulting engineering and product development, Cumberland, Md.

TALBOT, JOHN F., mechanic, foreman, R. M. Transport Co. Ltd., Rotorua, N. Z.

VAN DER SLUYS, WILLIAM, JR., instructor, Stevens Inst. of Technology, Hoboken, N. J.

VITZ, PAUL, superintendent, of maintenance, Arrow Carrier Corp., Paterson, N. J.

WHITE, LYSANDER T., sales, Henry L. Doherty & Co., New York City.

WILBER, G. R., president, Blood Brothers Machine Co., Allegan, Mich.

What Members Are Doing

Admiral Emory S. Land, chief of the Bureau of Construction and Repair, Navy Department, has agreed to act as chairman of the committee which awards the Collier Trophy for an outstanding aeronautical accomplishment of the past year. Other members of the Society who will serve on the committee are *Edgar S. Gorrell,* president, Stutz Motor Car Co. of America, and *Clarence M. Young,* former assistant secretary of Commerce for Aeronautics.

Of past awards of the Collier Trophy, all but two have gone to a member of the Society. Recipients were *Glenn L. Martin, Orville Wright, Grover C. Loening, Charles L. Lawrance* and *Harold F. Pitcairn.*

J. F. Winchester, supervisor of motor equipment, Standard Oil Co. of N. J., has moved his headquarters to 26 Broadway, New York City.

J. Howard Pile has been elected vice-president of the Chek-Chart Corp., Chicago. He continues as editor for the Corporation.

J. A. Purvis has been appointed associate editor of Chek-Chart. He was formerly technical editor of the *Automobile Trade Journal* and recently was advertising manager for the Weaver Mfg. Co.

Paul H. Geyser, president of the Terminal Cab Corp., has moved his offices to 1209 General Motors Bldg., 1775 Broadway, New York City.

Glenn S. Whitham, manager, Charles Street Garage Co., Boston, has been appointed a member of the Code Authority for the Motor Vehicle Storage and Parking Trade.

G. S. Whitham

T. L. Preble

T. L. Preble has joined the Tide Water Oil Co., New York City, as supervisor of automotive equipment. Mr. Preble was manager of the Pierce-Arrow Division of the White Co. and more recently has been connected with the sales department of the General Motors Truck Co.

Personal Opinions

(Being terse phrases spoken or written by Members or by their guests and ferreted from their context by an editor in an inquiring mood)

The manufacturer who will be able to offer a 1200 to 1500 hp. engine for equipment in a 15 to 20-passenger, single-engined airplane probably will have a profitable market.—*Charles Froesch*

◇

The manufacturer has been trying for years to assist the fleet operator. Most every one, however, has had considerable experience with vehicle salesmen who knew no more about transportation problems than a dry-goods salesman. There has been lately a very different trend. The attitude of the vehicle salesman toward transportation engineering has shown improvement.—*Harley W. Drake*

◇

It is a well-known fact that many gasoline carburetor engines give results, both as to power and economy, which cannot be considered good and which could be much improved were proper care taken to insure that equal charges of homogeneous mixtures which would burn completely, were distributed to all the cylinders all the time.—*F. H. Dutcher*

◇

Regardless of differences in detail, the following is probably true for all exhaust-gas vaporizing schemes using the divided-air principle: they require precision of action in their mixture-forming means, cannot use standard carburetors, are liable to service difficulties, tend to give inferior flexibility and are more costly to build.—*Dr. M. J. Zucrow*

◇

For aircraft, I believe we will in a few years arrive at a new engine using spark ignition, fuel injection and a special fuel having high anti-detonation qualities and high B.t.u. content per pound. It probably will be a two-cylce or four-cycle with the combustion chamber scavenged.—*F. C. Mock*

Stanley Whitworth is supervisor of appraisals for the Studebaker Corp., South Bend, Ind. He has been an industrial consultant in South Bend for some time previous to his new association.

C. B. Stebbins is vice-president and treasurer of the Taylor Management Engineering Corp., New York City. He was Eastern representative for the Waukesha Motor Co.

Vincent P. Rumely has returned to the Hudson Motor Car Co. as division superintendent in charge of trimming, car assembling, and domestic and export shipping.

Earl H. Smith has joined the Packard Motor Car Co., Detroit, as development engineer. He was assistant chief engineer, Pontiac Motor Co.

I.A.E. Secretary Retires

Basil H. Joy, since 1910 secretary of the Institution of Automobile Engineers (London), has resigned because of ill health. In reply to the communication from the I.A.E. announcing

Basil H. Joy

Mr. Joy's retirement, John A. C. Warner, secretary and general manager of the Society, replied in part as follows: "We have always counted Mr. Joy among our most helpful friends and associates, although we have never had the pleasure of meeting him personally.

"Undoubtedly the Institution will suffer a great loss because of his resignation."

Brian G. Robbins, assistant secretary of the I.A.E., becomes acting secretary with Mr. Joy's resignation. The change is effective as of March 6.

Henry H. Valpey is doing experimental engineering for the Eaton Mfg. Co., Cleveland. He was service manager for the Long Mfg. Co., Detroit.

Glenn Muffly's new address is 1827 Stratford Place, Springfield, Ohio.

R. S. Plexico, formerly designing engineer, Cole Engineering Co., Detroit, has joined the Chevrolet Motor Co. as assistant to the engineer in charge of chassis units.

Otto E. Fishburn, formerly research engineer, Warner Gear Co., has joined the Chrysler Corp. in Detroit.

Boyd V. Evans, former chief engineer of the Detroit Motor Bus Co. and lately of the Electric Service Supplies Co., is one of the organizers of a new company to be known as the Transportation Materials Co. with offices at 1916 Fairmount Ave., Philadelphia.

L. A. Chaminade, for the past 17 years executive engineer of the Studebaker Corp. in Detroit and South Bend, has joined the Chevrolet Motor Co. as engineer in charge of the chassis division on Chevrolet Master passenger-car construction.

Wellwood E. Beall, who has been in charge of engineering for the Boeing School of Aeronautics, has been transferred to the Boeing Airplane Co., Seattle, as sales engineer.

Earle S. MacPherson has joined the engineering staff of the General Motors Corp. For the last 12 years Mr. MacPherson has been associated with the Hupp Motor Car Corp., since 1931 as assistant chief engineer.

John W. Rix is toolroom foreman for the Waco Aircraft Co., Troy, Ohio. He was manager of the Martin Aeroplane Factory, Garden City, L. I., N. Y.

James A. Kemp has resigned from the Maudslay Motor Co., Ltd., Coventry, England, to join Albion Motors, Ltd., Glasgow, as chief designer.

George A. Gastineau is zone service manager in Detroit for the Chrysler Corp. Previously he was doing research work for Nathanson, Taylor & Smith, Inc., New York City.

Claude Batkin is in the engineering department (industrial engines) of the Frazier-Wright Co., Ltd., Los Angeles, Calif.

D. V. Goliaeff is technical director of the Moscow (Stalin) Auto Plant, Moscow 68, U.S.S.R. He was technical director of the Zavod A.M.O. (truck plant) in Moscow.

Gustave Sparre is with the Waco Aircraft Co., Troy, Ohio. He was formerly engineer and draftsman for the General Aviation Mfg. Co., Baltimore, Md.

Snowden E. Lea is with the Midland Steel Products Co., Cleveland, on brake development in the engineering laboratory. He was formerly inspector, experimental and development work for the Twin Coach Co., Kent, Ohio.

Charles A. Lendl is with the Consolidated Aircraft Corp., Buffalo, N. Y. He has been recently with the General Aviation Mfg. Co., Baltimore, as aeronautic engineer.

Eric Nygard is with the Scintilla Magneto Co., Inc., at Sidney, N. Y.

E. A. Nelson has joined the Motor Wheel Corp., Lansing, Mich. He was with Nelson Engineering, Detroit.

Wilbur C. Vaughan is general manager of the Vaughan Products Co., Portland, Ore.

Clarence Chamberlin as he testified before the Senate Committee on Post-offices. The Committee was investigating renewal of the air-mail contracts. Mr. Chamberlin is Vice-Chairman for Aeronautics of the Metropolitan Section of the Society

S. B. Eisenmann is ground engineer and pilot with Pan-American-Grace Airways. His mail address will be care of Pan-American-Grace, Lima, Peru. Mr. Eisenmann was formerly stationed at Barksdale Field, Shreveport, La., on active service in the Air Corps Reserve.

Edward W. Winegard has returned to Penn Yan Bodies, Penn Yan, N. Y., as designing engineer.

Robert B. Schenck, recently sales engineer, Pittsburgh Crucible Steel Co., has rejoined Buick Motor Co. as chief metallurgist, returning to a post from which he retired in 1932 after 17 years with the Buick organization.

C. G. Krieger

Chairman, Tractor and Industrial Power Equipment Committee **(see page 20)**

Walter D'Arcy Ryan

Walter D'Arcy Ryan, consulting engineer for the General Electric Co., died March 14 of heart trouble at his home in Schenectady. The history of modern illuminating engineering parallels Mr. Ryan's career with the General Electric Co. In 1903 when he received the title of illuminating engineer he was probably the first man in the country to be so designated.

Lighting effects at the Panama-Pacific International Exposition and the Century of Progress Exposition were Mr. Ryan's work and followed an artistic technic of which he was virtually the initiator. Mr. Ryan joined the Society in 1925 and interested himself in many aspects of highway and motor-vehicle illumination problems.

Jack Gray

Jack Gray, director of equipment sales, A. C. Spark Plug Co., died Feb. 21. Mr. Gray joined the Society in 1920 at which time he was sales engineer for the Champion Ignition Co. In 1925 he became sales engineer for the A. C. Spark Plug Co. and in 1929 was promoted to director of equipment sales. He was a member of the Detroit Section throughout his connection with the Society.

Benjamin F. Wright

Benjamin F. Wright, assistant chief engineer, Dodge Bros. Corp., commercial car division, died March 10 after a brief illness. He had been a member of the Society since 1922.

Other Deaths Reported

Other deaths reported during the past month, without further information, included those of David R. Swinton (M'13), vice-president and manager, Harris Products Corp., and sales manager of the leaf-spring division, Eaton Mfg. Co.; Patrick H. Brennan, Brennan Motor Mfg. Co., Syracuse; P. Yates Timmons, International Harvester Co. of America; and W. M. Hunter, Anderson, Ind.

News of the Sections

- Question-and-Answer Meeting
- An All-Service Vehicle
- Aluminum Combustion Chamber
- Stout Speaks at Washington

Spark-Ignition Fuel Oil Engines Discussed From Several Angles

• Metropolitan

THE general considerations in the use of non-volatile fuels with spark-ignition engines were presented by F. H. Dutcher, instructor in mechanical engineering, Columbia University, at the March 15 meeting of the Metropolitan Section. Mr. Dutcher's paper was followed by one on Paragon-type vaporizer installations, by Dr. M. J. Zucrow, and another on experiments on the vaporization of non-volatile fuels, by F. C. Mock, Eclipse Aviation Corp.

Mr. Dutcher reviewed the methods which have been considered in the effort to develop a gasoline-type engine which will satisfactorily operate on non-volatile fuels, such as furnace or heating oil, described briefly commercial examples of the use of these various methods, and finally analyzed the possibilities of these several processes with regard to power and efficiency. He then compared them, as well as the results to be expected from the use of motor gasoline, with those of an engine operating on aviation gasoline as a basic standard. Homogeneity is required to assure first, equal distribution between the several cylinders of a multicylinder engine; and second, that combustion shall be complete, for which reason also it is important that the chemically combining proportions be maintained.

There are three general methods of supplying low-volatility fuel-air mixtures, or fuel, to the class of engine under consideration, and the devices on the market and under development operate according to one or more of these methods.

(1) Preparation of an air-fuel-vapor mixture by evaporating the fuel in the presence of and mixing the vapor with all the air to be used.

(2) Preparation of an air-fuel-vapor-fog mixture by making a primary vapor by heating the fuel in the presence of either no air at all, or a small amount of air, and subsequent addition of secondary air in sufficient quantity to bring the total air-fuel ratio within the operating range.

(3) Direct injection of fuel into the combustion chamber, with ignition by spark.

Various types of vaporizer were described by Mr. Dutcher, who commented upon their effectiveness. His conclusions were that it is evident that it is not logical to expect as high power from an engine designed for satisfactory operation on gasoline when a less volatile fuel is used; that if it were possible to obtain complete homogeneity of the air-fuel charge, the injection type of low-compression spark-ignition oil-burning engine would deliver power more nearly approaching that obtained from gasoline than the other methods; and that the performance with fog-mixtures, while potentially not so good as that by the injection method, is considerably superior to that of wholly dry vapor-air mixtures.

These conclusions bear directly upon the power which can be developed from a given engine with a constant compression ratio, operating on several different fuels, Mr. Dutcher said, and he analyzed factors other than maximum brake mean effective pressure that can be developed by a given machine for certain classes of service.

Zucrow Presents Data

Dr. M. J. Zucrow presented, as a supplement to Mr. Dutcher's paper, some of his observations and experiences from both the laboratory and field with the exhaust-gas-heated vaporizer-types of heavy-fuel carburetion-systems. He pointed out, however, that some of the problems described are common, to a certain degree, to all schemes for burning heavy fuels.

A carburetion system of this type was developed for a six-cylinder, 5 x 5¾-in. engine used in inter-city bus-service. All or a portion of the air inducted by the engine passes through the carburetor where it is mixed with all of its fuel. The resulting fuel-air mixture then passes through the down-draft exhaust-gas-heated vaporizer. Three spiral paths are provided which whirl the mixture and spread the fuel in a thin film on the inner wall of the vaporizer. The body of air rushing by this heated film takes up its vapors and passes through the venturi outlet, where they are further co-mixed, through the manifold and then into the engine.

After discussing various features of this system, Dr. Zucrow presented the dynamometer results obtained from a 677-cu. in. engine equipped with this system and operated on Standard Oil No. 1 Furnace Oil. For comparison, the results of the same tests of the engine with its standard equipment and operated on gasoline were presented also.

Five heavy-fuel carburetion systems were placed in regular daily motorcoach service between Chicago and St. Louis and were operated for an aggregate of more than 400,000 miles, one unit being operated 135,000 miles. The performance of the engines from the standpoint of fuel consumption, dependability, oil dilution, power output and flexibility, was satisfactory. Minor difficulties were experienced with the lack of ruggedness of the standard carburetors used and with the electric fuel pumps; but once these were corrected, uninterrupted service was enjoyed.

Frank C. Mock said that some tests made several years ago by the Stromberg Carburetor Co. substantiate Mr. Dutcher's conclusions quite closely. He described a device, made purely for dynamometer-test purposes, which embodied an air chamber with an exhaust-heated floor having a large number of ribs, so that it could reach quite high temperatures, also equipped with a slide of heat-insulating material by which the exposed area of heating surface could be regulated. With this device, an engine was run on a large variety of fuels, and perhaps the most important conclusion developed was the necessity for adequate temperature of the heating surface, as the fuel spray was found to exert a very marked cooling effect, and the floor temperature was considerably lower than had been expected.

After this experience, Mr. Mock said that a fuel heater was made for road-test experiments. It was cylindrical in shape, about 6½ in. in diameter and was used to handle the mixture from a standard side-outlet carburetor, bolted to the flange indicated. This air entrance from the carburetor was tangential to the cylinder in plain view so that the air entered with an anti-clockwise whirl, passed around and down the side wall in a relatively thin film, and then, still whirling anti-clockwise, rose up through the center and passed out of the volute, which was like that of an ordinary centrifugal water-pump, and thence to the intake manifold. The floor of this centrifugal chamber was formed by a corrugated copper-alloy dish, exposed to the exhaust gas on its bottom side. The tangential mixture entrance and downward air travel tended to throw all unvaporized fuel onto the side wall and thence down to the heating surface. Above the dish was located a heat shield of alternate asbestos and metal discs, which had holes in its center.

Whirl Generates Suction

The vortex whirl of the air generated a marked suction at these holes, so that there was a continuous circulation of some air down the outer wall into the dish, along with the fuel drops, and up the center holes, along with fuel vapor. Taking the air outlet tangentially at the top conserved the airflow energy and avoided the pressure drop experienced with devices of this sort when the air outlet is taken from the center. Also, the tangential outlet made it possible, in the device as used, to put a circular 4-in. window in the top so that conditions inside might be clearly observed.

Mr. Mock said that this device was driven for several months on a large variety of fuels. Practically complete separation and retention of all liquid drops was obtained and the fuel fog could be seen to rise through the central holes of the separator plate and diffuse through the inner chamber.

Joseph A. Anglada, president, Anglada Motor Corp., was chairman of the meeting, which was attended by about 250 members and guests of the Metropolitan Section.

Froesch Describes Airline Operations

• Baltimore

Operating, servicing and economic factors in air-line operation were covered broadly by Charles Froesch, sales and service engineer, General Aviation Mfg. Corp., in a paper on "Some Aspects of Commercial Aviation" at the March 8 meeting of the Baltimore Section. The meeting was attended by 84 members and guests and the dinner preceding it by 62.

In discussing operations, Mr. Froesch compared flying costs on two types of transport planes, one popular during the last few years, and one recently introduced into service. His comparison showed that in the case of the two planes total direct expense per flying hour has increased from $26.18 to $34.41 but that direct flying cost per mile and cost per passenger-seat mile have been reduced from $0.221 to $0.207 and $0.0368 to $0.0207 respectively.

Pointing out that structural improvements do not always repay the extra cost they involve, he said: "When it is realized that the purchase price of an airplane is responsible today for about 20 to 25 per cent of its direct flying costs of operation, due to depreciation and insurance, the importance of low manufacturing costs needs serious consideration. It is true that higher speeds offset this to a certain degree but when they are obtained by the use of retractible landing gear, to cite but one instance, drag is reduced but the initial cost of the airplane is increased considerably."

Present air-line equipment will be found too small in the next two years, according to Mr. Froesch. Sleeping accommodations will have to be provided, now that noise problems have been solved to the extent that sleep is possible.

The importance of servicing in the airplane-factory sales program was emphasized by Mr. Froesch, who showed several pictures of service layouts, including the hexagon hangar used by Western Air Express.

The Department of Commerce project for a light airplane was touched upon by Mr. Froesch. He gave a sample schedule of manufacturing costs for a plane to meet the specifications laid down by the Department and concluded that such a plane could not be produced and sold, probably, for less than $1425. Mr. Froesch's figures were based on a two-passenger plane with a 90 hp. engine; weight empty 1000 lb.

Visits Truck Exhibit

At the Feb. 13 meeting of the Baltimore Section, George C. Scragg, executive, Brockway Motor Co., welcomed members and guests to the Brockway exhibit then being held in Baltimore. A talk by Mr. Scragg was followed by refreshments.

Buffalo Officers Pay a Call North

• Canadian

Officers of the Buffalo Section were guests of the Canadian Section on March 21. Harry M. Bramberry, Perfect Circle Co., was the speaker at the meeting.

Passenger cabin in Douglas transport plane; a recent development in high-speed transcontinental flying (• Baltimore)

Hexagonal hangar for aircraft repairs used by Western Air Express (• Baltimore)

Q. and A. Program Found Successful

• Northwest

The chairman of the program committee, Northwest Section, Society of Automotive Engineers, provided a new type of meeting for that group at the March 9 meeting in Seattle.

C. H. Bolin, the chairman, devised a plan of assigning four men to four phases of discussion of the automotive powerplant. No set papers or talks were made, but each engineer selected to answer questions took his position at the head of the table, while the men present fired questions at him. To each subject 30 minutes time was allotted. There was no dearth of questions and Sherman Bushnell, chairman of the Section, who presided, had to call time on each of the subjects. At the windup there was some general questioning, with all four men called upon to continue their role of expert-answering.

John G. Holmstrom, chief engineer of Kenworth Motor Truck Corp., was selected to answer general questions on the broad subject of "The Gas Engine". Most of the questions concerned merits of steel-back bearings, copper-lead bearings, spun con rods and counterbalanced shafts. Spun rods, the speaker said, have caused less connecting-rod trouble. Crankshafts reached the peak for size about three years ago, he stated, and had been made larger to decrease deflection.

Reese Lloyd of Sunset Electric Co. handled the second subject; "Electrical Systems". Silver and platinum contact points, voltage regulators on generators, batteries, lamps, spark intensifiers, use of a foreign patented oxide for batteries, for better cold weather starting, constituted the drift of questioning on this subject. Mr. Lloyd considered spark intensifiers of doubtful value. If the spark is sufficient to ignite gas mixture, a larger one is of no advantage, he stated.

"Carburetion and Fuels" was the topic handled by E. L. Cline of the Ethyl Gasoline Corp. He exhibited three types of exhaust gas analysers. A garage test with these instruments, he stated, was sufficient for all practical purposes, showing very little variation from road tests.

"Lubrication" was the fourth and final topic, with George A. Zamboni, Northwest representative for Sinclair Refining Co., on this phase of the evening's education. Graphited lubricants were first discussed. Fluid friction, he declared, was increased by proper use of graphite. That the public should use lighter grades of lubricating oils was brought out by Mr. Zamboni, as meaning longer engine-life. "The first law of lubrication," he said, "is to use

the lightest possible oil which means better lubrication."

Top cylinder lubrication he considered desirable, especially during the "breaking in" period. However graphite in overhead oil will increase detonation he stated.

Aluminum's Use Told by DeStaebler

● St. Louis

Thirty-five members and guests of the St. Louis Section attended a meeting on Feb. 21 at which Herbert DeStaebler, Aluminum Co. of America, spoke on "The Use of Aluminum in the Transportation Field." The meeting was preceded by a Governing Board dinner in honor of Mr. DeStaebler.

"All-Service Vehicle" Claimed Practical

● Cleveland

Giving an affirmative answer to the question, "Is it possible to unite into one vehicle at a reasonable cost all of the desirable qualities of street cars, trolley-buses and gasoline motor-buses?", Martin Schreiber, general manager in charge of plant, Public Service Coordinated Transport, Newark, N. J., described to the Cleveland Section at its March 12 meeting how this synthesis can be accomplished and cited experimental tests to substantiate his contentions.

"All that needs to be done," Mr. Schreiber said, "is to take an ordinary type gas-electric bus now in general service, install a set of trolley poles on its roof and substitute the present electric controller for a double one so that the driver of the vehicle can shift from one operation to the other at will. Although it may be necessary at times for the driver to leave his seat to place the trolley poles on the wire, as is the case with street cars and trolley-buses, when leaving the wires he can automatically remove the trolley poles by simply pressing a button actuating an electric retriever.

"A new dual controller," continued Mr. Schreiber, "also regulates the electricity that flows from the generator to the two propulsion motors attached to the gasoline engine when the vehicle is used as a gas-electric bus. In addition it controls the current supplied to the same propulsion motors when the trolley pole shoes are in contact with the overhead wires. The propulsion motors are wound up approximately 250 volts and when connected to the 500-volt trolley wires they are placed in series across them.

"The dual controller of the 'all service vehicle' may be operated either by hand or foot lever. To make full use of both operations at will, the lighting generator should be connected with one of the propulsion motors. If air brakes are used, in addition to the air pump connected to the gasoline engine, another air pump should be driven by the propulsion motor."

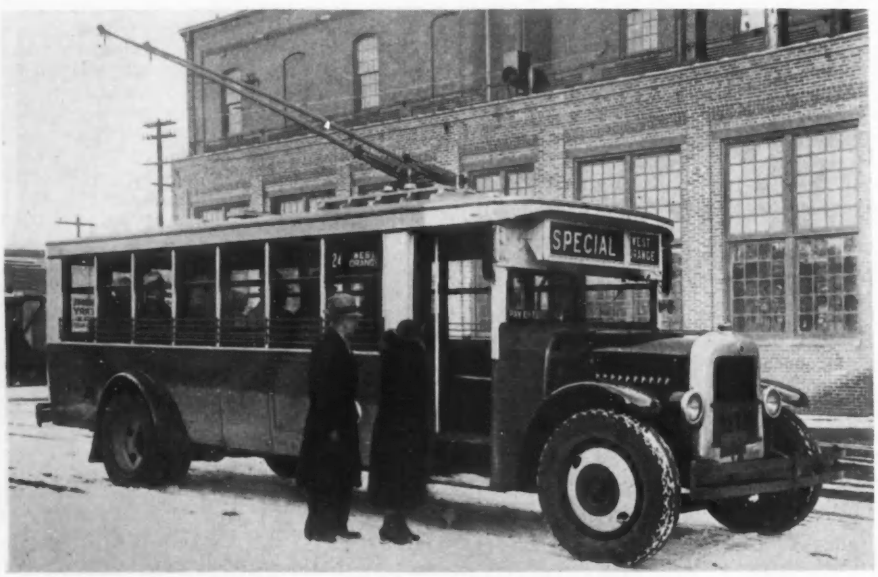
The first "all-service vehicle", Mr. Schreiber said was tested experimentally at Weehawken, N. J., on Jan. 11, 1934, and its performance equalled that of an average passenger car as regards maximum speed on a selected route which included a long 6 per cent grade. The equipment used in the Weehawken experiment was made with a gas-electric bus eight years old which had previously operated more than 300,000 miles.

"If the principles that have been expounded hold under these conditions," Mr. Schreiber concluded, "we should be able to prove them in a better way if full advantage would be taken of modern design."

One hundred and fifty members and guests attended the meeting and a lively discussion included comment from Morgan Evans, Columbus Traction, Power and Light Co.; George Green, vice-president, General Motors Truck Co.; Guy Wilson, General Electric Co., and Pierre V. C. See, Akron Transportation Co.

Mr. Morgan spoke of the extraordinary success his company is having with trolley-buses, while Mr. Green said that the gas-electric vehicle gives rapid acceleration and good performance with a minimum of driver effort, adding that, when a satisfactory continuous mechanical-type torque converter is developed, it will have a wide field in transportation equipment.

Mr. Wilson expressed the belief that the trolley-bus is quiet, safe and in many ways ideal for the transportation industry. Mr. See stated that, while an all-service vehicle might be of service under certain special conditions, he questioned whether it was not somewhat in the same class as the amphibion atuomobile which can travel on water or land.



The gas-electric bus equipped as an "all-service vehicle" which Martin Schreiber discussed at March meeting of Cleveland Section. It is a 1926 model and had run 318,332 miles before being converted for the test run described by Mr. Schreiber. (●Cleveland)

Uses of Welding Told and Shown

● Dayton

The modern use of gas welding in aluminum and stainless steel fabrication was discussed by Owen C. Jones, technical department, Linde Air Products Corp., in a paper presented March 12 at a joint meeting of the Dayton Section and the Dayton Chapter of the American Society for Testing Materials.

Welding of thin-gage materials, tubing, tipping of tools, templet cutting and brazing were some of the topics covered in the paper. The meeting was attended by 110 members and guests of the two societies. A film showing various specific applications of welding was used by Mr. Jones.

Combustion-Chamber Shapes

A great deal of work has been done on aluminum cylinders for aircraft engines and it is a matter of only a short time before they will be found in service, according to Frank Jardine, chief engineer, castings division, Aluminum Co. of America, who spoke on "Aluminum Combustion Chambers" at the Feb. 12 meeting of the Dayton Section.

Aluminum cylinders should also be used in future automotive engines to obtain a better power-weight ratio, he indicated.

Mr. Jardine's paper described the development and trend of aluminum pistons. With the advent of the aluminum cylinder-head, his company conducted a series of experiments on combustion-chamber design.

The results of these tests that "there is not a great deal of difference between the most commonly used combustion-chamber shapes and there is very little difference between any of these shapes. Given a specific shape which is desirable from some other standpoint, it should be possible to develop this shape to a point where it is equal to the best shape already shown for a specific engine. It would seem logical to conclude, therefore, that the shape of the combustion-chamber is not as important as is commonly believed."

"For general design recommendations," said Mr. Jardine, "tests indicate that a clearance of 1/16 in. to 3/32 in. above the valve is satisfactory; 3/32 in. to 1/4 in. around the back of the valves and as much as possible ahead of them. The width of the transfer area should be approximately 75 per cent of the bore diameter and the swept volume of the cylinder divided by the transfer area should give a factor of 15 to 20. The masked area can vary considerably and should be allowed to come what it will after obtaining a satisfactory angle over the piston."

Stout Describes Railplane Tests

● Washington

W. B. Stout, president, Stout Engineering Laboratories, Inc., Dearborn, Mich., described his Railplane at the March 7 meeting of the Washington Section, which was attended by several representatives from the office of the Federal Coordinator of Transportation, Joseph B. Eastman.

Total attendance included about 75 members and guests of the Section.

Manufacturer-Operator Cooperation Stressed

● New England

Through the courtesy of the Eastern Massachusetts Street Railway Co., the New England Section held its March meeting in the Campello Shops, Brockton, Mass. At this centrally located point all major repairs to the 245 buses of this far-flung transportation system are concentrated. Members and guests to the number of 152, constituting a new high record for the Section, sat down to a dinner served in the somewhat unusual environment of a very modern and immaculate service station.

Two papers on modern bus maintenance and shop practice were read by W. C. Bolt and H. T. Hurlock, respectively, superintendent and assistant superintendent of rolling stock and shops. The former traced the development and evolution of maintenance systems and policies established over the past eleven years, since his company started from "scratch" in 1922 to operate automotive equipment, which has now largely superseded their traction equipment.

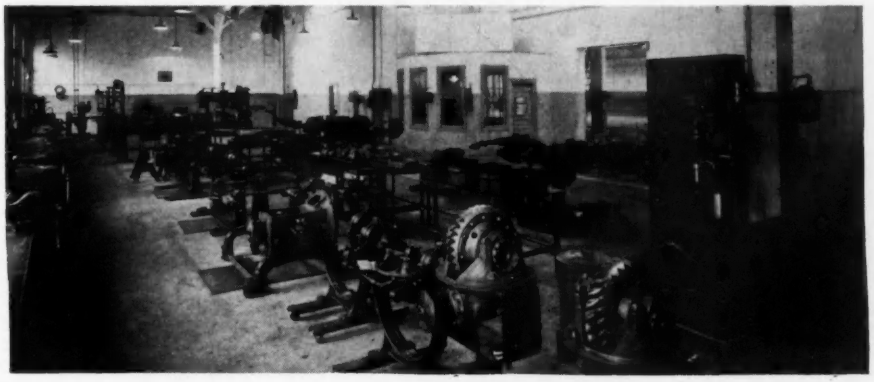
Manufacturers deserve a great deal of credit, Mr. Bolt said, for the time and energy, to say nothing of the large sums of money spent in development, which have resulted in the tremendous progress of the last 12 years. "It was rather difficult," he said, "to convince manufacturers that a motor vehicle suitable for city and suburban transportation should closely approximate the design of the electric car, particularly with respect to size, location of doors, arrangement and spacing of seats, step heights, adequate illumination, heating and comfortable riding characteristics.

"We are proud of the work which has been accomplished," he continued, "through joint effort of manufacturers and operators, and we are now able to provide the traveling public with transportation on rubber tires, which is safe, comfortable and reasonably fast."

Mr. Hurlock's paper preserved the continuity of the general subject, taking up in detail the various methods evolved for motor overhaul, body overhaul, unit replacements, testing procedure, oil reclamation, etc. Data on comparative costs were furnished together with an explanation of the improved efficiency and economy secured through the installation of many special tools and testing facilities not usually found in a shop of this character.

Following the meeting, an inspection of the premises was made and demonstrations were given of the dynamometer, crankshaft grinder, air brake test bench, fuel pump testing equipment and other special devices. The latest models of A.C.F's. and Twin Coaches were placed over pits to afford a worm's eye view of powerplant and chassis construction.

Altogether, the meeting was a huge success and entirely justified the large attendance it drew. Special bus transportation was provided between Boston and Brockton. Chairman Alfred Devine presided and Capt. S. S. Burgey and E. Philip Finn perfected the arrangements.



Unit-overhaul department in the Campello Shops of the Eastern Massachusetts Street Railway Co. The shops were visited by the New England Section as part of its March meeting. (●New England)

Air Developments Described by Two

● Indiana

More than 300 members and guests of the Indiana Section attended the March 15 meeting in Indianapolis at which aviation developments were outlined by two speakers. L. W. Fritz, of Transcontinental & Western Air, read a paper on "New Airline Advancements—Maintenance and Operation," which was written by Jack Frye, vice-president of T.W.A. Capt. James A. Taylor, U. S. Army Air Corps, described development and test work at Wright Field, Dayton, Ohio. Two reels of motion pictures of Wright Field operations were shown. Attendance was 76 at the dinner which preceded the meeting.

DeLancey & Franklin Share a Program

● Kansas City

Messrs. DeLancey of Plymouth and Franklin of Reo were the speakers at the Kansas City Section meeting on Feb. 16, which was attended by 15 persons. The subjects were "Independent Front-Wheel Suspension" and "Automatic Transmissions" respectively. Mr. DeLancey showed sound pictures of the Plymouth car and Mr. Franklin demonstrated a cut-away model of the Reo self-shifting transmission.

Trend in Trucks Charted by Cass

● Pittsburgh

All trucks built in the future will be designed with engine, cab and axle positions so arranged as to approximate for one body length on each wheelbase a load distribution approaching 1/3-2/3, in the view of Robert Cass, assistant chief engineer, White Motor Co., who was the speaker at the Feb. 21 meeting of the Pittsburgh Section.

Mr. Cass pointed out that legislative restrictions may have considerable bearing on the design of future trucks. "If the Federal government could enact legislation to make all state laws for trucks uniform", he said, "the problem from the design standpoint would be completely simplified".

Cautioning his audience that in say six months from now there might be a material change in the trends of truck design, Mr. Cass broadly covered present developments in his paper on "Future Trends in Motor Truck Transportation."

Large-output engines should have at least 12 cylinders in the opinion of the speaker, with the logical development in the direction of a V-type or horizontal engine.

Of Diesel engines, Mr. Cass believes that the unpleasant character of the exhaust would produce protests from the public were they operated on any quantity on city streets. He pointed out also that increased efficiency of the gasoline engine may materially reduce the gap in fuel economy now separating the two types of engine, particularly if tighter specifications on Diesel fuels result in a substantial price increase.

Referring to increased interest in automatic transmissions, torque convertors, etc., he said that he was inclined to believe that the future would find a combination using present gear-type transmissions plus some sort of hydraulic absorption-device between the engine and the transmission. Such a combination, he believes, would take precedence over any form of automatically operated transmission.

With the trend toward engine-under-the-cab models and with greater weight on the front axle there will be probably a call for power steering, either air or hydraulic. Power brakes will be universal, according to the speaker, even on light trucks. Steam cooling will get more consideration and chassis built integrally with the body will find wider use, he concluded.

Pittsburgh Section To Hear C. E. Wilson

C. E. Wilson, vice-president of General Motors Corp., will speak at a joint luncheon meeting of the Pittsburgh Section and the Pittsburgh Chamber of Commerce on Thursday, April 19, on the general subject of "The Importance of the Automobile to the Return of Prosperity to Pittsburgh's Diversified Industries".

Pittsburgh produces iron and steel in many forms, plate glass, coal and coke and their by-products, gasoline and oil, which explains why Pittsburgh's prosperity is so closely linked with that of the automotive industry and why Pittsburgh's business men will be so glad to hear what Mr. Wilson has to say on this subject.

The Pittsburgh Section of the S.A.E. states that "while automobiles may be completed in Detroit, it is the quality of Pittsburgh materials that gives them such a splendid start".

This luncheon meeting will be held in the auditorium of the Pittsburgh Chamber of Commerce, and John S. Fisher, president of the Pittsburgh Chamber of Commerce and ex-Governor of Pennsylvania, will welcome the S.A.E.

From Then to Now In the Body Art

● Detroit

The future development of streamlining will determine ultimately the design of the chassis as well as the shape of the body, in the opinion of J. Engelhard, who was the speaker at a meeting of the Detroit Section Body Activity on Feb. 12.

In his paper Mr. Engelhard drew on an ex-

perience in body building which dates back to an association with Carl Benz, the German inventor of the automobile. Looking backward to that time, he cited the progress in the body art as applied to automobiles as being "remarkably slow."

In general, he pointed out, the trend in body design throughout the period has been toward simplification of overall design which results finally in the streamlined form.

As streamlining approaches perfection, the work of artists and designers will be turned from aesthetics to geometry, he said, but qualified this statement with the opinion that so long as body design is a large factor in the public acceptance of new automobiles the public is not likely to accept cars which look alike from the lowest price-bracket to the highest. Design and appearance will continue to be the dominating factor in the success of the automobile and allied body industry, he believes.

Past-Chairmen Are Honored

• Chicago

Past-chairmen of the Chicago Section turned out in force at its March 6 meeting which was designated as "past-chairmen's might." Harold Nutt, present chairman of the Section, introduced the following past-chairmen: Taliaferro Milton, R. E. Wilson, J. W. Tierney, E. W. Stewart, O. R. Schoenrock and L. V. Newton. He also read a letter from past-chairman F. G. Whittington expressing regret at his inability to be present.

Delmar G. Roos, president of the general Society, spoke briefly in appreciation of the past-chairmen's contribution to the work of the Section and the Society as a whole.

The technical part of the March 6 program included a paper on "The Development of Diesel Engines for Industrial and Agricultural Tractors," by C. B. Jahnke, research engineer, International Harvester Co., and another by A. P. Yerkes, editor, *Tractor Farming*, of the International Harvester Co., on "The Economics of the Development and Use of Tractors." Joint discussion of both papers was led by Chairman Nutt and R. E. Wilson of the Standard Oil Co. of Ind.

New Technique Shown For Indicator Diagrams

• Milwaukee

J. C. Slonneger, experimental engineer, Falk Corp., Milwaukee, was the chief speaker at the March 7 meeting of the Milwaukee Section which was attended by 75 members and guests.

Mr. Slonneger presented a new method of interpreting indicator cards. The method uses a supplementary card without ignition as the basic curve of the engine. A series of curves with absolute pressures 2, 3 and 4 times those shown by the supplementary card are used as a background and compared with the indicator card (with ignition). The progress of combustion and the end of effective combustion can be traced, since the intersection of the actual card with the several curves in the background locates points in the piston travel at which it may be assumed that equal amounts of heat have been added to the system.

Mr. Slonneger also read a paper prepared by Hans Fischer, which analyzed typical indicator cards from Otto and Diesel engines, using this method. Cards from rough and smooth engines and the basic differences in combustion were analyzed, and finally a card was drawn as the goal to be sought.

Section Visits Portland Shops

• Oregon

A visit to the City of Portland's municipal shops was made jointly on Feb. 16 by the Oregon Section, S.A.E., and the Oregon Section, American Society of Mechanical Engineers. It was the first joint meeting of the S.A.E. and A.S.M.E. Oregon Sections. The attendance was 75. J. Verne Savage, superintendent of the Portland shops and treasurer of the Oregon Section, conducted.

Mougey Presents Lubricants Data

• Philadelphia

More than 200 members and guests of the Philadelphia Section turned out March 7 to hear H. C. Mougey, assistant technical director, General Motors Research Laboratories, talk on crankcase lubrication and the 10W and 20W lubricants. J. Bennett Hill, chief chemist, Atlantic Refining Co., was chairman of the meeting.

News of the Society: National Tractor Meeting at Milwaukee

(Continued from page 20)

EVENING SESSION

Topic—Research in Agriculture
Speaker—S. H. McCrory, U. S. Dept. of Agriculture
Session Chairman—H. C. Dickinson, National Bureau of Standards, Past President, S.A.E.

THURSDAY, APRIL 19

MORNING SESSION

Topic—Requirements of Tractor and Industrial Engines
Speaker—A. C. Staley, Chrysler Corp.
Session Chairman—A. W. Lavers, Minneapolis Moline Power Equipment Co.

AFTERNOON SESSION

Topic—Chemical Hay for Mechanical Horses
Speaker—R. E. Wilson, Standard Oil Co. of Ind.
Session Chairman—C. G. Krieger, Ethyl Gasoline Corp.

In addition to Mr. Krieger, personnel of the committee sponsoring the meeting includes: J. W. Shields, Firestone Tire & Rubber Co.; A. J. Blackwood, Standard Oil Development Co.; R. C. Chesnutt, Cleveland Tractor Co.; A. T. Colwell, Thompson Products, Inc.; O. E. Eggan, Oliver Farm Equipment Co.; C. E. Frudden, Allis Chalmers Mfg. Co.; R. B. Gray, U. S. Dept. of Agriculture; E. R. Jacoby, Continental Motors Corp.; A. W. Lavers, Minneapolis Moline Power Implement Co.; Elmer McCormick, John Deere Tractor Co.; W. H. Radford, Caterpillar Tractor Co.; T. B. Rendel, Shell Petroleum Corp.; C. W. Smith, University of Nebraska; L. B. Sperry, International Harvester Co.; A. C. Staley, Chrysler Corp.; R. E. Wilken, Standard Oil Co. of Ind.

It is expected that among others, the following important leaders in this industry will be present also to contribute their experience and ideas.

Lindsay Donaldson, vice-president, Massey-Harris Co.; H. C. Merritt, general manager, Tractor Division, Allis Chalmers Mfg. Co.; C. R. Messinger, chairman of board, Oliver Farm Equipment Co.; H. B. Dinneen, vice-president, Minneapolis Moline Power Implement Co.; C. B. Jahnke, research engineer, International Harvestor Co.; J. T. Jardine, chief, office of experiment stations, U. S. Dept. of Agriculture; Elmer McCormick, chief engineer, John Deere Tractor Co.; Earl Moree, chief engineer, Massey-Harris Co.; C. E. Frudden, chief engineer, Allis Chalmers Mfg. Co.; R. C. Chesnutt, experimental engineer, Cleveland Tractor Co.; W. H. Radford, chief engineer, Caterpillar Tractor Co.; L. B. Sperry, International Harvestor Co.; J. H. Holloway, consulting engineer, Northwest Engineering Co.; K. G. Mackenzie, consulting chemist, The Texas Co.; T. B. Rendel, head, Automotive Research Laboratory, Shell Petroleum Corp.; Earl Bartholomew, director, Engineering Laboratory, Ethyl Gasoline Corp.; L. R. Anderson, Chairman Automotive Technical Committee, Socony-Vacuum Co.; W. W. Lowe, Henry L. Doherty & Co.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Bibliography on Skin Friction and Boundary Flow

Compiled by A. F. Zahm and C. A. Ross. Issued by the Library of Congress, Division of Aeronautics, City of Washington, 1934; 46 pp. [A-1]

This bibliography covers the works which treat of the surface velocity and friction of fluids in steady motion along solid boundaries at moderate Reynolds' numbers. The main theme of the papers listed is the determination, by theory or experiment, of the velocity distribution in the boundary layer, and the attendant skin friction, of slightly viscous fluids such as air and water.

The Lift Acting on a Flat Plate in a Stream Bounded by an Infinite Plane Wall

By Susumu Tomotika. Report No. 100 of the Aeronautical Research Institute, Tokyo Imperial University, January, 1934; 42 pp., with tables and charts. [A-1]

The Lift on a Flat Plate Placed in a Stream Between Two Parallel Walls and Some Allied Problems

By Susumu Tomotika. Report No. 101 of the Aeronautical Research Institute, Tokyo Imperial University, January, 1934; 71 pp., with tables and charts. [A-1]

Aerodynamic Characteristics of Anemometer Cups

By M. J. Brevoort and U. T. Joyner. N.A.C.A. Technical Note No. 489, February, 1934; 7 pp., 12 figs. [A-1]

Tank Tests of Auxiliary Vanes as a Substitute for Planing Area

By John B. Parkinson. N.A.C.A. Technical Note No. 490, February, 1934; 7 pp., 6 figs. [A-1]

Tank Tests of a Family of Flying-Boat Hulls

By James M. Shoemaker and John B. Parkinson. N.A.C.A. Technical Note No. 491, February, 1934; 13 pp., 44 figs. [A-1]

The High-Speed Tank of the Hamburg Shipbuilding Company

By G. Kempf and W. Sottorf. Translated from *Werft-Reederei-Hafen*, June 1, 1931. N.A.C.A. Technical Memorandum No. 735, February, 1934; 12 pp., 12 figs. [A-1]

Effect of Fuselage and Engine Nacelles on Some Aerodynamic Properties of an Airplane Wing

By Joan Vladea. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vo. 24, No. 20, October 28, 1933. N.A.C.A. Technical Memorandum No. 736, February, 1934; 9 pp., 11 figs. [A-1]

CHASSIS PARTS

Transmission Principles

By L. H. Pomeroy. Published in *The I.A.E. Journal*, November, 1933, p. 26. [C-1]

The author points out that great advances usually come in response to great needs, and that after the very long period in which the Panhard type box reigned supreme it may be anticipated that there is plenty of scope for far greater development and improvement than has yet occurred. Mr. Pomeroy predicts that there will be some mechanical generalization analogous to the invention of the crank and connecting-

(Continued on page 36)

NOTES AND REVIEWS

Continued

rod which will solve this problem of converting a given speed and torque into any other required speed and torque in a far simpler and more economical manner than is now available. The object of this paper is to state the motor car aspect.

The Development of a Constant-Periodicity Suspension System

By S. A. Horstmann and C. Ainsworth Davies. Published in *The I.A.E. Journal*, January, 1934, p. 14. [C-1]

It is pointed out that there can be no question as to the advantage of a suspension that will automatically change its characteristic to suit any increase or decrease in load, and if it were possible to provide a freedom of suspension system with absence of recurring oscillations, yet without the damping devices which are necessary with the use of leaf springs, such an arrangement would be more or less ideal.

The authors have been connected with the development of constant-period suspension systems for a number of types of vehicles. The type of automatic suspension with which they deal has both the above aims in view, and they contend that these ideals have been to a great extent attained in the suspension which they have already constructed.

Electrical Equipment for Automobiles

By E. A. Watson. Published in *The I.A.E. Journal*, January, 1934, p. 32. [C-1]

This is Part II of a paper which appeared in the Proceedings of the I.A.E., Vol. 27 (1932-33), p. 184. In Part I, the author dealt with the major items of the electrical equipment of a car, namely, the starter, dynamo, ignition, and lighting. The object of Part II is to describe what may be termed the minor items, such as windshield wipers, horns and warning signals, direction indicators, indicating instruments, and fuel pumps; and in addition to deal with the vital subject of the installation and wiring of the equipment itself.

La Boîte Électro-Mécanique Cotal

By René Charles-Faroux. Published in *La Vie Automobile*, Dec. 25, 1933, p. 641. [C-1]

A new electro-mechanical transmission developed by the French inventor Cotal is here described.

ENGINES

Aero Engine Design

By G. S. Wilkinson. Published in *The I.A.E. Journal*, February, 1934, p. 10. [E-1]

This paper constitutes a general review of the progress that has been made with aircraft engines. The author shows how the performance of aircraft engines has been improved during the past 18 years, mentioning briefly some of the factors which influence design, and giving some indication as to the probable course of development during the next 12 years or so.

Preliminary Report of the Research and Standardization Committee on Valve-Seat Wear

Prepared by C. G. Williams. Published in *The I.A.E. Journal*, March, 1934, p. 21. [E-1]

The investigations on valve-seat wear have been proceeding for about a year, and the author points out that although a stage of finality has not yet been reached, it is considered that sufficient data have now been obtained to warrant the issue of a preliminary report.

The present report is divided into two sections. The first describes wear tests with particular reference to the influence of temperature and valve closing velocity, while the second section deals with the results of measurements of exhaust valve and seat temperatures on various engines. Experiments are still being continued on various aspects of the problem.

The Modern High-Speed Diesel Engine, and Its Place in Road Transport

By W. H. Goddard. Published in the *Journal of The Institution of Petroleum Technologists*, November, 1933, p. 885. [E-3]

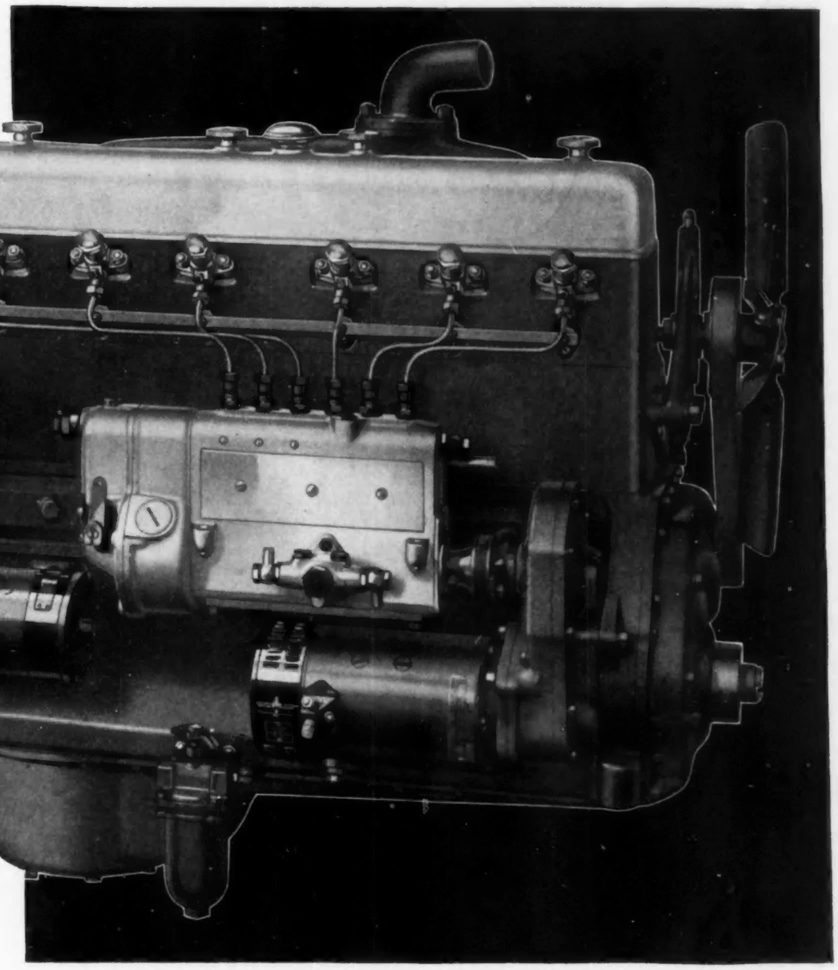
This paper constitutes a brief résumé of five and one-half years' experience with the use of the high-speed Diesel engine in road transport in England.

Le Moteur Diesel à Grande Vitesse

By Henri Petit. Published in *La Vie Automobile*, Feb. 10, 1934, p. 43. [E-1]

A contrast is drawn between the engines now included under the

(Continued on page 38)



NOTES AND REVIEWS

Continued

term Diesel and the type envisaged in the original patent. The present state of Diesel engine developmnt is discussed under the following headings: fuel injection, combustion chambers, two versus four stroke cycle, ignition lag, turbulence, knocking, general design features and starting. The criticisms concerning rough running, smoky and malodorous exhaust and high manufacturing and maintenance costs are answered.

Les Combustibles Pour Moteurs Diesel à Grande Vitesse

By P. Maillard. Published in *La Vie Automobile,* Feb. 10, 1934, p. 56. [E-1]

Diesel fuels may be drawn from five sources, but the major proportion of those used are derived from petroleum. A table gives the characteristics of five petroleum fuels and the field of use for each. The general characteristics of Diesel fuels, cetene numbers, viscosity and ignition temperature are then discussed. Other topics are the special requirements of aviation and industrial fuels and the properties of vegetable oils.

Les Pompes et Les Injecteurs

By René Charles-Faroux. Published in *La Vie Automobile,* Feb. 10, 1934, p. 60. [E-1]

Detailed descriptions are given of fuel pumps and injectors on current automotive Diesel engines.

Der Gegenwärtige Stand der Leichtgewichts-Dieselmotoren

By A. E. Thiemann. Published in *Automobiltechnische Zeitschrift,* Feb. 10, 1934, p. 53. [E-1]

A 50 per cent increase in r.p.m. and a 50 per cent decrease in weight per horsepower are two outstanding items in the Diesel engine progress of the last three years. This is among the conclusions set forth in this summary of recent Diesel engine development, which is a leading article in an issue devoted to this topic. Each important engine part is treated separately and ample tables present performance and design specifications. Succeeding articles describe current Diesel models.

Untersuchungen an Schnellaufenden Auflade-Drehkolbenverdichtern

By Dr.-Ing. Herbert J. Venediger. Published in *Automobiltechnische Zeitschrift,* Dec. 10, p. 579 and Dec. 25, 1933, p. 619 [E-1]

Eccentric rotary type superchargers in their present form possess the defects of insufficient effectiveness at low speeds and too great power consumption at high speeds. This conclusion is drawn from the results of an investigation of the Zoller and Powerplus devices and recommendations are made tending toward the improvement of this type of supercharger.

HIGHWAYS

Die Bedeutung der "2000 Km durch Deutschland" für die Reichsautobahnen

By A. Liese. Reprint from *Verkehrstechnik,* Jan. 5, 1934. 5 pp., 7 ill. [F-1]

To determine the reactions of drivers to various types of road surface the automobile club of Germany sent a questionnaire to the participants in the recent 1200 mile tour. In this article are summarized the answers to 8 questions dealing with the effect of various surface types on permissible speed, security, grade climbing and visibility.

L'Eclairage de la Route Nationale No. 185 de Paris à Versailles par Ville-d'Avray

Published in *Le Génie Civil,* Jan. 13, 1934, p. 36. [F-4]

Illumination by sodium vapor lamps is the feature of the demonstration highway lighting system installed on the Paris-Versailles road. Incandescent lamps are used on one section and sodium vapor lamps on the other. The construction and operation of the two types are here contrasted, to the advantage of the latter which is said to furnish 2.3 times the candlepower of the incandescent lamp for the same current consumption.

MATERIAL

The Alloys of Iron and Tungsten

By J. L. Gregg. Published for *The Engineering Foundation* by the McGraw-Hill Book Company, Inc., New York and London, 1934; 511 pp., illustrated. [G-1]

This is the third volume of the monograph series. The aims of this

(Continued on page 40)

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TIMKEN *Tapered Roller* **BEARINGS**

NOTES AND REVIEWS

Continued

and other monographs have been described in reviews of the previous volumes.

The author explains that although published abstracts have been used in locating original literature and for eliminating duplicate and secondary articles, the original sources of the important data have been studied, specially abstracted or translated, and the articles themselves consulted repeatedly in the preparation of the monograph. More than 1800 articles were located, and abstracts of over 1300 of these were made. Of these, 566 appear in the selected bibliography at the end of the monograph.

Ozone, Knock-Inducer Extraordinary

By Donald B. Brooks. Published in the *Journal of The Institution of Petroleum Technologists,* October, 1933, p. 835. [G-1]

The author describes experiments, using a Cottrell precipitation apparatus attached to the intake of the C.F.R. Engine, which have resulted in considerable data on the effects of ozone.

Mr. Brooks believes that the following conclusions, based on the tests described, may be stated with assurance:

(a) In ozone a new tool for the study of detonation and the testing of theories thereof has been discovered.

(b) The effects of ozone and tetraethyl lead on fuels, while opposite, are of the same order of magnitude.

(c) Different amounts of ozone are required to counteract an equal improvement in the anti-knock value of a fuel obtained by use of different knock inhibitors.

(d) The detonation of different fuels is affected to a materially different degree by admixture of ozone in the intake air.

(e) In the concentrations tried, ozone is without measurable effect on power, economy, or optimum spark advance.

Knocking Characteristics of Naphthene Hydrocarbons

By Wheeler G. Lovell, John M. Campbell, and T. A. Boyd. Published in *Industrial and Engineering Chemistry,* October, 1933, p. 1107. [G-1]

The relative tendencies to knock in an engine have been measured for sixty-nine naphthene hydrocarbons. These measurements were made, not on the hydrocarbon alone, but in admixture with gasoline, and the results have been expressed, as in previous work, by using the anti-knock effect of aniline as the standard of comparison.

Upon this basis there appear great differences among the knocking properties of these compounds and even among isomers. The relations between structure and tendency to knock of these naphthenes appear quite consistent and also consistent with the previous relations found for the paraffin and the aliphatic olefin hydrocarbons.

Cellulose Acetate Plastic Improves Laminated Safety Glass

By George B. Watkins and Joseph D. Ryan. Published in *Industrial and Engineering Chemistry,* November, 1933, p. 1192. [G-1]

The development of a satisfactory cellulose acetate plastic and methods of bonding this plastic to glass surfaces has resulted in a marked improvement in the quality of laminated safety glass. The history of the development of cellulose acetate plastic in its application to safety glass manufacture is briefly discussed. A comparison of the properties of cellulose acetate and cellulose nitrate plastics important to the safety glass manufacturer, as well as to the results of comparative tests conducted on laminated safety glass made with both types of plastic, are outlined and illustrated. Data and photographs are presented to show the protection afforded by cellulose nitrate and cellulose acetate laminated safety glass as compared with ordinary glass glazings.

Chemical Nature of Gum-Forming Constituents in Gasoline

By Donal T. Flood, J. W. Hladky, and Graham Edgar. Published in *Industrial and Engineering Chemistry,* November, 1933, p. 1234. [G-1]

The problem of determining the source of gum in gasoline has been attacked by an investigation of individual hydrocarbons of the type likely to be formed by cracking processes. These were added in varying amounts to straight-run paraffinic gasoline and the mixtures subjected to the usual tests for gum stability as well as to storage tests. The effectiveness of inhibitors is demonstrated and their action is shown to consist in a prolonging of the induction period without apparently affecting the rate of oxygen absorption once the induction period is finished. A comparison of storage test with oxygen bomb data is also included.

Lubricating Properties of Greases from Petroleum Oils

By F. H. Rhodes and Harold Dwaine Allen. Published in *Industrial and Engineering Chemistry,* November, 1933, p. 1275. [G-1]

The authors contend that in lubrication by soda-base greases the soap plays an important part in the formation of the lubricating film. The glycerol present aids in stabilizing the structure of the grease, reduces the change in consistency on heating or working, increases the lubricating power, eliminates the increase in the coefficient of static friction on

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Concluded

heating, and reduces the susceptibility to moisture. They conclude that greases containing an amount of glycerol equal to two or three times the quantity equivalent to the sodium soap present are much better lubricants than are those that contain merely the amount equivalent to the soap. With larger quantites of glycerol, the lubricating value again decreases.

Die Verchromung unter Besonderer Berücksichtigungihrer Anwendung im Automobilbau

By Dr.-Ing. E. H. O. Bauer, Prof. H. Arndt, and Dr.-Ing. W. Krause. Published by M. Krayn, Berlin, Germany. 256 pp.; 216 illustrations. [G-1]

This investigation into chromium plating with especial reference to its use in automobile construction was carried out at the government materials' testing laboratory with the support of the German national automobile chamber of commerce.

Its object was to determine the suitability of the various plating methods for producing a plated piece adequate for its intended purpose. About 60 plated parts from current production and special test pieces were investigated. Items investigated included the chemical composition, thickness and uniformity of the plating, its appearance, adhesion, deformation, hardness wear resistance, temperature and corrosion resistance.

Proceedings Fourteenth Annual Meeting of the American Petroleum Institute, Chicago, Ill., October 23-26, 1933, Section II (Marketing)

Published by the American Petroleum Institute, New York City, 1933; 99 pp. [G-3]

In addition to those papers previously reviewed from preprints, Section II on Marketing of the Proceedings includes the following papers of automotive interest: Chassis Lubricants, by H. C. Mougey; How the Automobile Industry Can Help Itself by Aiding the Petroleum Industry, by A. L. Clayden; The Effect of Automobile Design on Vapor Lock, by O. C. Bridgeman; Methods of Testing Automobiles for Potential Vapor Lock, by W. G. Ainsley, L. E. Baker and E. B. Phillips; Effect of Design and Other Factors on the Servicing and Operation of Motor Vehicles, by J. F. Winchester; The Use of Personally-Owned Cars in Company Service, by L. V. Newton; Operating the Modern Vehicle with Air Brakes and Air Control, by S. Johnson, Jr.; and What the Motor Vehicle Manufacturer Can Do to Assist the Fleet User in His Problems, by W. L. Shaffner.

MISCELLANEOUS

Le Nouveau Régime Fiscal de l'Automobile, en France

By G. Delanghe. Published in *Le Génie Civil,* Feb. 10, 1934, p. 129. [H-1]

An analysis of the new system of automotive taxation which went into effect on Feb. 1, 1934, is made. This system shifts the basis of taxation to fuel consumption, all liquid automotive fuels, including Diesel fuels but exempting alcohol blends under certain conditions, being taxed. A comparison is made with the automotive taxation systems in ten European countries.

PASSENGER CAR

L'Aérodynamisme Vrai: la Mistral de Pierre Mauboussin

By René Charles-Faroux. Published in *La Vie Automobile,* Jan. 25, 1934, p. 28. [L-1]

Streamlining is bound up with the questions of frame structure, safety and economy. How the designer of the aerodynamic Mistral took these factors into consideration is here developed. Topics covered are aerodynamic brakes, methods of testing streamlined models and of developing streamlined forms and the adaptation of transmission reduction ratios to a streamlined car. Curves show the power required by the Mistral and by a conventional closed car for propulsion and for overcoming wind resistance. The Mistral is said to be unaffected by cross winds.

Analysis of the Automechanics Trade

By David F. Jackey and Benjamin W. Johnson. Published by the State Department of Education, Sacramento, Cal., 1933; 206 pp., illustrated. [L-2]

To meet a state-wide demand for instructional material in the automechanics trade, the Commission for Vocational Education of the California State Department of Education, in cooperation with the Division of Vocational Education of the University of California, has prepared this bulletin to be used by teachers, automechanics, auto repair men, employers, and administrators in industry and education.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Bleicher, C. E.
External Broaching

Boelter, L., and Rusk, D. O.
The Relation of the Mechanical Construction of Headlamps to Their Performance Upon the Roadway

Brettell, Clinton
How Economies in Motor Vehicle Operation Can Be Effected from an Operator's Standpoint

Briggs, Commander W., and Fox, M. L.
Body Noise

Broulhiet, Georges
Quality Objectives for Engineers—An official communication from the Societe des Ingenieurs de l'Automobile de France

Brown, W. C., and Roper, V. J.
The Well-Lighted Car

Bull, A. W.
Tire Noise

Cass, Robert
Future Trends in Motor Truck Transportation

Chandler, F. F.
Notes on Steering

DeSmet, E. C.
Planography—The New Science of Surface Design

Drake, H. W.
Problems of the Fleet Operator

Dutcher, F. H.
The Low Compression Ignition Oil Engine

Falge, R. N.
Modern Headlighting Requirements

Fisher, J. B.
Combustion Problems on Automotive Diesel Engines

Fisher, J. B., and Bower, L. L.
Trends in Tractor Engine Design

Fitzsimmons, J. T.
Problems and Tendencies in Electrical Equipment

Fodor, Nicholas
Hydraulics of High-Speed Fuel Injection

Foley, Hamilton
Manufacture and Magnetic Inspection of Hollow-Steel Propellers

Froesch, Charles
Some Aspects of Commercial Aviation

Frye, Jack
Aircraft Maintenance on Scheduled Service
New Airline Advancements: Maintenance and Operations

Gagg, R. F., and Farrar, E. V.
Prediction of Altitude Performance of Aircraft Engines with Gear-Driven Superchargers

Haarz, W. G., Jr.
Beauty Sells Cars in 1934

Hazard, S., Jr.
Sound Absorption and Deadening

Horner, F. C.
Looking Forward in the Field of Transportation

Hunsaker, J. C.
Airships for Commercial Purposes

Jacoby, E. R.
Practical Design Consideration of the Internal Combustion Engine Structure

Johnson, W. M.
A Résumé—and Some Conclusions

Kuttner, Julius, and Rippere, J. B.
Ignition Delay of Diesel Fuels Measured by Bouncing Pin in C.F.R. Engine

Lansing, R. P.
Starters for Diesel Engines

Lichty, L. C., and Carson, G. B.
Engine Friction Analysis

Macauley, J. B.
Fuel Economy from the Engine Designer's Point of View

Mock, F. C.
Utilization of Heavy Fuel With Spark Ignition

Moss, F. A.
Air Conditioning and Relative Refinements for Auto Bodies

Norris, R. F.
The Automobile Motor Considered as a Sound Source

Nutt, Arthur
Detonation Rating of Aviation Fuels

Orr, J. M.
Predetermined Operating Requirements for Purchasing Equipment

Peterson, C. D.
Multi-Range Transmissions

Prescott, F. L.
High-Output Poppet-Valve Cylinders

Prudden, T. M.
Noise Treatment in the Automobile

Rendel, T. B.
European Automotive Diesels

Robertson, D. D.
Hydraulic Action in Piston Ring Design

Rothrock, A. M.
A Photographic Study of Combustion in a High-Speed Compression-Ignition Engine

Schreiber, Martin
The All-Service Vehicle

Shepard, E. H.
The Economy Fallacy

Smith, C. W.
Comparative Tests of Pneumatic Tires and Steel Wheels on Farm Tractors in Agricultural Operations

Stewart, J. P., and Risk, T. H.
Factors Affecting Oil Consumption

Teetor, R. R.
Conformity of Cylinders, Pistons and Rings

Treiber, O. D.
Factors in Automotive Diesel Development

White, L. T.
Why Waste Fuel Through the Exhaust?

Zucrow, M. J.
Some Experiences with Heavy Fuel Equipment for Spark Ignition Engines

News of the Sections

Vidal and Northup Tell Future Trends

● Detroit

"The pioneers of aviation have conquered the air. Our task is to develop that conquest into a national heritage," said Eugene L. Vidal, director of aeronautics, U. S. Department of Commerce, in a talk made to the Detroit Section on April 16.

Amos E. Northup, chief body designer, Murray Corp., the other featured speaker, had as his topic "Future Streamlining". Further details of this interesting meeting will be available for the June issue of the S.A.E. JOURNAL.

Early Motoring Features Told

● Oregon

March 9 was Ladies Night at the Oregon Section Meeting, held at Lloyd's Golf Club, Portland. There was a dinner attended by 34, and several more couples turned out for entertainment and dancing which followed.

Ray Conway, manager, Oregon State Motor Association, spoke on "Early Motoring in Oregon". Surface treatment of roads, which began in Oregon in 1905, and the first automobile show in the state, held in 1906, were cited by Mr. Conway as milestones in the development of motoring.

The April 13 meeting of the Section was devoted entirely to business and was open only to members. It was preceded by a dinner.

Coil-Spring Movies Shown by Franzen

● Baltimore

Tore Franzen, experimental engineer, Chrysler Corp., was the speaker at the April 5 meeting of the Baltimore Section. Illustrating his talk, Mr. Franzen showed motion pictures of the laboratory work entering into the production of coil springs for independent front-wheel suspensions. The meeting was attended by 58 members and guests of the Section.

Application of Rubber Described by Schippel

● St. Louis

The plastic property of rubber permits the incorporation in it of materials to meet particular requirements of service, it was pointed out by Henry F. Schippel at the March 22 meeting of the St. Louis Section. Mr. Schippel who is design and development engineer of the B. F. Goodrich Co., tire division, took as his subject "The Uses of Rubber for Transportation."

Streamlining of automobiles, Mr. Schippel believes, was brought about as much to reduce wind noises which became more pronounced with reductions made in the noises generated by the powerplant as it was by the desire to reduce wind resistance. With reduction of wind noises, he pointed out, tire noises became more pronounced and it was necessary to redesign treads for reduction of objectionable noise.

Pneumatic-tire installations have been designed for tractors resulting in increased speed, reduced fuel consumption and greater comfort to the operator. Application of the so-called zero-pressure pneumatic has been made to road-building equipment he said. With this design the tire "packs" a track for itself in soft material and stays on top of it. A cross-section of this tire which has no inner tube is a shallow inverted U.

Pneumatic tires cannot be used on road scrapers on account of chattering, Mr. Schippel said.

The St. Louis meeting was attended by 25 members and guests of the section and was preceded by a dinner for the Board of Governors and the speaker.

"Cab-Over-Engine" Trucks Argued

● Metropolitan

An outline of developments in design of "cab-over-engine" trucks by Joseph Geschelin, engineering editor, *Automotive Industries,* discussion of this same topic by B. B. Bachman, vice-president, Autocar Co., and A. J. Scaife, consulting field engineer, White Co. and description of standardization of military motor equipment by Capt. W. C. Thee, Q. M. Corps, U. S. Army, were features of the Metropolitan Section meeting on April 19. Prominent in discussion which followed the papers were M. C. Horine, Maurice Walter, and Herbert Chase.

Mr. Bachman mentioned among advantages of the "cab-over-engine" design the following: It gives the operator more room; it permits easier handling; heat can be kept back of the driver; cab need not be made so wide; floor board height can be kept lower; hand brake lever can be kept in center of chassis where it does not interfere with getting into or out of the cab.

Mr. Scaife said that "there is no question but that the design of the future will be centered around the 1/3-2/3 weight distribution feature." He believes, however, that there will also be a considerable demand for the so-called fore-shortened type and that these two different types of vehicles will fit into practically all types of transportation so far as can be seen at the present time.

Mr. Geschelin said in part, regarding trends and future developments in motor-truck design, that from now on the truck buyer must select his heavy-duty equipment from a group of vehicles described as "cab-over-engine", "engine-under-seat", "camel-back", "traffic" and other terms yet to be coined. The thing to bear in mind, he continued, is that, essentially, all these terms are intended to describe a vehicle of a specific design called "close-coupled", which features a weight distribution of one-third of the gross weight on the front axle and two-thirds on the rear. He then accepted the situation as it exists in its present development and viewed it objectively concerning the reasons for its adoption, its general advantages together with a brief examination of each individual make, general design-considerations and the potentialities of what might be termed "unconventional" engine-design.

Limitation on rear-axle loading, limitation of gross weight, and limitation on the overall length of single units and combinations were the three legal requirements which wrote the specifications for the new construction, so far as Mr. Geschelin could learn.

Future possibilities are largely hedged about with many variables, not the least of which is a guess as to the probable trend of State legislation, Mr. Geschelin said. But he suggested an interesting possibility when he asked: Wouldn't the "close-coupled" construction be of benefit in some of the lighter truck classifications?

The special advantages of the new construction were stated by Mr. Geschelin to be *(a)* ideal weight distribution for tires; *(b)* shorter turning radius and, consequently, better maneuverability; *(c)* an increase in gross load with the same body-length; and *(d)* increased loading space within prescribed length limitations.

Mr. Geschelin concluded that it seems obvious, from an analysis of designs now in production, that the various truck organizations have been able to produce a vehicle which is safe, comfortable and as easy to operate as the conventional job; also, one which is not particularly difficult to service.

In his paper on Standardization of Military Motor Equipment, Capt. W. C. Thee stated in part that the Army test-fleet developed at Camp Holabird results from the valuable data obtained by operating motor vehicles in the sands of Mexico, the mud of France and, during the last fifteen years of the operation of motor transportation during peace times, throughout the United States and its foreign possessions. Study of such experience furnished information for the standard vehicle which, during the war, was the Class B 3-ton truck; but this did not become an actuality in France for duty in the World War. To obviate such a delay in the future, the pilot test-fleet was developed at Camp Holabird.

The pilot test-fleet is composed of six groups of vehicles, Captain Thee continued. Within each group are from three to four series which make up various types of trucks with capacity payloads from 1,000 to 20,000 lb. The different series can be developed from each group by assembling a vehicle for four-wheel, two-wheel drive or four-wheel drive; and for six-wheel, four-wheel drive or six-wheel drive. Within a maximum of 3 hr., any vehicle can be converted from a two-wheel drive to a four-wheel drive.

Mind vs. Micrometer Presented by Veal

● Washington

"The research worker who has learning without imagination is like a fellow 'all dressed up with no place to go' ", C. B. Veal, research

manager of the Society, told a Washington Section gathering on April 11.

Mr. Veal's title was "Mind or Micrometer", P. R. Wheeler, mechanical engineer, Navy Department, spoke at the same meeting on "Human Engineering".

Warning his audience that "imagination must not be relied on to ascertain definitely measurable facts, although the estimate of an experienced imagination is often as valid as measurements", Mr. Veal developed a strong case for the utilization of imagination in engineering.

Taking each of the fields of work in automotive engineering, he showed how applied imagination had advanced materially the state of the art.

Imagination in industrial engineering is particularly important, according to Mr. Veal.

"The industrial engineer, in my opinion, is destined to replace the defunct efficiency expert and the discredited banker as the general adviser to business", he said.

"The industrial engineer must be at home in all the fields of engineering. . . design, research, operation and maintenance and production. His job is the sum of all these jobs, so must his imagination be a compact of the imagination required in each of them."

Repair Equipment Discussed by Two

• Northwest

Instruments and shop equipment used for analysis of engine troubles and repair service of vehicles were the subjects of the April meeting of the Northwest Section, held in Seattle.

J. F. Best, Super Brake Service, Seattle, and George C. Webster, shop equipment department manager, Ballou & Wright, Seattle, were the speakers. Mr. Best discussed instruments and equipment used in chassis work, particularly wheel alignment, axle and frame straightening.

Mr. Webster concentrated on modern equipment for powerplant analysis and repair.

A round-table discussion followed presentation of the two topics. The meeting was attended by 31 members and guests of the Section.

Education Topic at F & S Meeting

• Cleveland

Two hundred and fifty members and guests of the Cleveland Section heard George W. Smith, Jr., vice-president in charge of production, White Motor Co., talk on "A Technical Education" at the annual Father and Son Meeting on April 9. Ferdinand Jehle was toastmaster.

Mr. Smith outlined the prejudices that have existed toward men with college degrees, and stated that the technical graduate has often been considered to be quite narrow in both education and viewpoint. The student, as one educator has put it, largely educates himself. Education of self by self is a matter of hard intellectual toil. One of the criticisms of our education today is that the student does not learn, as did Sir Isaac Newton, to study a subject until it "glows".

Dr. R. B. Jones, director of the Cleveland Public High Schools, in commenting on the paper, stated that he felt that the educators' problem was what to do with the poorer type of individual. There would always be room at the top for the best minds—we would always crowd them into action, but the schools just cannot correct the individual's habits after 16 or 18 years of wrong and improper training at home. The limits to which the intelligent individual could go who had health, training and character, were boundless.

C. V. Thomas, president of Fenn College, stated that the most important thing to the student is discovery of that "something" which was "thrilling" and which will hold him fascinated while he mastered the subject. Industry should place, and hold such students, and train them to solve its problems.

Dean Theodore M. Focke of Case School of Applied Science; A. Caswell Ellis, director of Cleveland College; Prof. F. H. Vose of School; Col. W. G. Wall, A. J. Scaife and E. E. England, also spoke of the limitations of our present educational system, and of the desirability of some form of education which would permit the student to get a broad general education before specializing.

Guernsey Sketches Rail Car Outlook

• Philadelphia

C. O. Guernsey, chief engineer, J. G. Brill Co., spoke on "The Future Rail Car" at the meeting of the Philadelphia Section, April 18. A summary of his remarks appears on page 20 of this issue.

B. B. Bachman was chairman of the meeting, while among those prominent in the discussions were E. R. Gurney, E. J. W. Ragsdale, A. K. Brumbaugh, Joseph Geschelin, H. F. Huf, and R. K. Supor.

Pope Describes Hesselman Engine

• Chicago

Oil and gas fuels were subjects of the Chicago Section meeting April 3 at which Dr. D. P. Barnard, 4th, assistant director of research, Standard Oil Co. (Indiana) spoke on "Butane versus Gasoline as a Transport Fuel" and A. W. Pope, Jr., research engineer, Waukesha Motor Co., spoke on "The Waukesha-Hesselman Engine—Its Design and Application."

The Hesselman engine can no longer be called experimental, according to Mr. Pope. They have been used for industrial service and are therefore of relatively low speed but there are engines which have operated at 3000 r.p.m. Brake mean effective pressures of 104 lb. have been obtained on a production Waukesha-Hesselman industrial engine of 6½ in. bore. Laboratory models have shown appreciably higher outputs.

Production engines will show a full-load fuel consumption of less than 0.58 lb. per b.hp. per hr. and a ¾ load fuel consumption lower than 0.52 lb. per b.hp. per hr., Mr. Pope said. The engine is started on gasoline supplied to the manifold by strokes from a conventional primer pump and it was stated that the engines operate satisfactorily on standard No. 2 or No. 3 furnace oil. Other fuels are satisfactory with specified limitations.

The Hesselman engine, Mr. Pope said, is less sensitive than carburetor engines to the detonation of fuels. Compression ratios are now being used in production which allow the engines to operate without excessive detonation on most fuels encountered.

An important feature of the Hesselman cycle is the method of throttling the intake gear to provide combustible mixtures at the spark plug. At ¼ to ¾ load there is a certain amount of stratification by the air and combustible mixture. It is this partial stratification at part load which produces the gain of the carburetor engine, Mr. Pope pointed out.

On present engines throttling is accomplished by mechanical linkage between the fuel pump and the balanced barrel type throttle valve. Production has begun however on a new type vacuum control of the fuel pump, eliminating all mechanical linkage.

Photo Cell Uses Described by Brees

• Dayton

Dr. R. G. Stott, radio speaker and humorist, addressed the April 12 meeting of the Dayton Section on "Leisure Moments in an Engineer's Life." Prof. Paul R. Brees, Wittenberg College, spoke on "The Photo-Electric Cell in Industry."

The Dayton Section meeting was held jointly with the Cincinnati Chapter, American Institute of Electrical Engineers and the Dayton Chapter of the American Society of Metals.

Prof. Brees predicted that development of the photo-electric cell would enable human beings to literally "see in the dark." Blind flying of airplanes, he said, would be discarded as by the use of the photo-electric cell the pilot would be able to see through the thickest fog, smoke or clouds.

Huckle & Warner Divide a Program

• New England

Diesel engines will dominate ultimately the light marine, railway, motor-truck, motorcoach, aircraft and semi-portable power field, according to Myron S. Huckle, president of the United States Diesel Corp., who was a speaker at the April 10 meeting of the New England Section. John A. C. Warner, secretary and general manager of the Society, was a guest at the meeting. Mr. Warner exhibited motion pictures which he took last June upon the occasion of the Section's annual outing. Mr. Warner gave a talk on S.A.E. activities. The meeting drew 132 members and guests of the section.

New England, Mr. Huckle pointed out, has not manifested an interest in Diesel engines equal to that of some other sections of the country, as it is lagging about 40 per cent behind in installed horsepower. By contrast he said 70 per cent of all motor-trucks and coaches operating in England are Diesel-engined powered.

Advances in Trim Materials Shown

• Canadian

At the April 19 meeting of the Canadian Section members and guests present numbered 115. The speaker was Stewart M. Ford, vice-president and general manager of Collins & Aikman, Ltd., Farnham, Quebec. His subject was, "Trim Materials." Mr. Ford covered the weaving and finishing of cloth material, with particular reference to plushes and velvets, from the time of the old hand loom up to the present highly specialized mechanical looms.

He gave a clear picture of the manufacturing process of trim materials through the past few years, and demonstrated how these materials had been improved in texture, finish, wearability and fadeability.

(Continued from page 28)

Victor W. Wagner is engine tester for the Winton Engine Co., Cleveland.

Emil A. Nelson is mechanical engineer in charge of research for the Motor Wheel Corp., Lansing, Mich.

S. J. Cheney is dynamometer laboratory assistant in the experimental department of the Pontiac Motor Co.

William S. Pritchard was recently made master mechanic and director of safety of the Midland Steel Products Co., Detroit.

James S. Henry is with the Gulf Refining Co. in the Houston, Tex., office, studying motor-truck routing and performance. He was formerly with the Humble Oil & Refining Co. in technical supervision of a truck fleet.

L. K. Marshall has been appointed general parts and service manager, Pontiac Motor Co., combining his former position of service manager with that of the parts and accessories merchandise manager, who has resigned.

W. C. Dodge, Jr., vice-president of Ferodo & Asbestos, Inc., has been elected president and chairman of the Sub-Code Authority of the Brake-Lining Division of the Asbestos Code.

M. F. Judd, Raybestos-Manhattan, Inc., is also a member of the Sub-Code Authority.

E. V. R. Thayer has been re-elected vice-chairman of the board of directors of the Stewart-Warner Corp., Chicago.

L. D. Seymour is a member of the board of directors and president of the newly organized American Airlines, Inc. He was formerly president of American Airways.

Arthur R. Fors has resigned as general works manager, Continental Motors Corp., and has joined the Chrysler Corp. manufacturing division.

A. R. Fors

A. S. Van Halteren

Andrew S. Van Halteren has been appointed development engineer of the Firestone Steel Products Co., Akron. He was formerly executive engineer of the Motor Wheel Corp., Lansing, Mich.

Irving D. Wallach is an apprentice naval architect with H. B. Nevins, Inc., City Island, New York. He was formerly a joiner with the Federal Shipbuilding and Drydock Co., Kearny, N. J.

Hugh J. McGinty is on the sales staff of the Ford Motor Co. of Canada, Ltd., St. John, N. B. He was formerly stationed at East Windsor, Ont.

D. T. Gleason, formerly factory manager, has been elected a vice-president and director of the Standard Steel Spring Co.

Harry E. Figgie has also been elected a vice-president and director of the company.

H. R. McMahon was re-elected president.

E. K. Baker, former president of the Baker Wheel & Rim Co., Detroit, has joined the Hoover Steel Ball Co., Ann Arbor, Mich.

Harold P. Berry is senior tool and gage designer at the Naval Gun Factory Navy Yard, Washington, D. C. He was process engineer for the R.C.A.-Victor Co.

Harold M. Page, formerly zone instructor in Boston for the Chevrolet Motor Co., has been transferred to the company's engineering department in Detroit and is doing special field work.

George D. McCormick has joined the Prestone Division of the National Carbon Co., as field engineer.

L. C. Eldridge has been appointed manager of the lubricating department of the Shell Petroleum Corp., St. Louis.

B. G. Symon has been made his assistant.

Deaths Reported

Deaths of the following members have been reported to the Society: Akiyoshi Matsumoto, of the Japan Automobile Co., Tokyo; Frederick Edward McAdam (in Bucharest), European district manager, Firestone Tire & Rubber Export Co.; and Allen B. Patterson, automotive engineer, Texas Co., Chicago.

Meetings Calendar

S.A.E. Summer Meeting

Saranac Inn, Saranac Lake, New York, June 17-22, 1934.

Canadian—May 16

Royal York Hotel, Toronto; dinner 7:00 P.M.

Automotive Opportunities in Transportation—William B. Stout, president, Stout Engineering Laboratories, Inc.

Chicago—May 1

Hotel Sherman; dinner 6:30 P.M.

Light-weight and High-Speed Passenger Train Development—M. P. Winther, railcar engineer, Pullman Car & Mfg. Corp.

Cleveland—May 18

Meeting will be held at the plant of the Timken Roller Bearing Co., Canton, Ohio; dinner 6:30 P.M.

Yearly outing of the Section; there will be golf in the morning, an inspection trip through the factory in the afternoon, and dinner and meeting in the evening.

Dayton—No meeting

Detroit—May 28

Detroit Yacht Club; dinner 6:30 P.M. Toastmaster—C. F. Kettering. Speaker—A. G. Herreshoff, assistant chief engineer, Chrysler Motor Corp.

Metropolitan—May 17

The Roger Smith, New York City; dinner 6:30 P.M.

A Critical Study of Car Design and Performance—Austin M. Wolf, consulting engineer.

New England—No regular meeting

Northern California—May 7

Engineers Club, San Francisco; dinner 6:30 P.M.

What's Going on in Automotive Engineering—D. G. Roos, chief engineer, Studebaker Corp.

Quick Glimpses of S.A.E. Achievements—John A. C. Warner, general manager, S.A.E.

Northwest—May 11

Engineers, Arctic Bldg., Seattle; dinner 6:30 P.M.

What's Going on in Automotive Engineering—D. G. Roos, chief engineer, Studebaker Corp.

Quick Glimpses of S.A.E. Achievements—John A. C. Warner, general manager, S.A.E.

Oregon—May 9

Lloyd's Golf Club House, Portland, dinner 6:30 P.M.

What's Going on in Automotive Engineering—D. G. Roos, chief engineer, Studebaker Corp.

Quick Glimpses of S.A.E. Achievements—John A. C. Warner, general manager, S.A.E.

Philadelphia—May 9

Inquirer Building; dinner 6:30 P.M.

Economics of Light Commercial Bodies—William Naegel, chief engineer, Bender Body Co.

St. Louis—May 17

Coronado Hotel; dinner 6:30 P.M.

Piston Rings and Conditions that Affect Their Performance— R. R. Teetor in charge of Engineering Department, Perfect Circle Co.

Southern California—May 3

Cafeteria, Richfield Oil Bldg., Los Angeles; dinner 6:30 P.M.

What's Going on in Automotive Engineering—D. G. Roos, chief engineer, Studebaker Corp.

Quick Glimpses of S.A.E. Achievements—John A. C. Warner, general manager, S.A.E.

Washington—May 2

University Club, Washington, D. C.; dinner 6:30 P.M.

Floating Airports on the High Seas with Special Reference to the Armstrong Proposal for Transatlantic Airways— Edward R. Armstrong.

Demonstration of model seadrome and movies depicting construction.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between March 10, 1934, and April 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ALBERTSON, SCOTT M. (A) manufacturers representative, Andrews-Albertson Co., 218 Lexington Building, Detroit.

ALTER, HORACE JULES (J) design draftsman, Edo Aircraft Corp., College Point, L. I., N. Y.; (mail) 1914 East 27th Street, Brooklyn, N. Y.

BARNES, REX I. P. (M) engineer, Wilkening Mfg. Co. (Canada) Ltd., 43 Britain Street, Toronto, Ontario, Canada; (mail) 17 St. Joseph Street.

BLACK, IRA K. (M) superintendent, automotive maintenance, Honolulu Rapid Transit Co., Ltd., Honolulu, Hawaii; (mail) 1133 Alapai Street.

EISENHAUER, CHARLES BOND (J) engineer, Anderson Mfg. Co., 195 Albany Street, Cambridge, Mass.; (mail) 95 Magazine Street.

FIELD, EMMET J. (J) graduate student, internal combustion engine, University of Minnesota, Minneapolis; (mail) 73 Clarence Avenue, South East.

FITZGERALD, J. N. (A) division manager, Ethyl Gasoline Corp., 302 Bay Street, Toronto, Ontario, Canada.

FOSTER, ARCH L. (M) refining technology editor, National Petroleum Publishing Co., 1213 West Third Street, Cleveland.

FOX, LELAND W. (M) manager, service stores laboratory, Firestone Tire & Rubber Co., Akron, Ohio.

FOY, BYRON C. (A) vice-president, Chrysler Corp.; president, De Soto Motor Corp., Detroit; (mail) Chrysler Building, 405 Lexington Avenue, New York City.

FUCHS, HENRY OTTEN (M) Delco Products Corp., Dayton, Ohio; (mail) 331 Grafton Avenue.

HAGENLOCH, WILLIAM FREDERICK (J) field service and contact man, Carter Carburetor Corp., 2834 North Spring Avenue, St. Louis, Mo.; (mail) 912 President Street, Brooklyn, N. Y.

HORGAN, RALPH THOMAS (A) vice-president, treasurer, Kroger-Jonas, Inc., 1828 First Avenue, New York City.

ISOM, EDWARD W. (M) vice-president, charge, patent and developing, Sinclair Refining Co., 45 Nassau Street, New York City.

KREULEN, HERMAN P. (M) vice-president, treasurer, Spring City Foundry Co., Waukesha, Wis.

LAMBRIX, MAURICE A. (J.) engineer, Gear Processing, Inc., 6700 Grand Avenue, Cleveland.

LANGE, A. R. (M) technical director, Swan Finch Oil Corp., 205 East 42nd Street, New York City.

LEE, WARREN K. (M) sales engineer, Wilkening Mfg. Co., 2000 South 71st Street, Philadelphia; (mail) 218 Lexington Building, West Grand Boulevard, Detroit.

MACKENZIE, WILLIAM J. (M) sales manager, chief metallurgist, Alloy Steel Division, Youngstown Sheet & Tube Co., 111 West Washington Street, Chicago.

ORTEGREN, HERMAN A. (M) chief draftsman, Bower Roller Bearing Co., Detroit; (mail) 3998 Beaconsfield Avenue.

ORTMANN, FRED (A) electrician, W. H. Flaherty Co., 48 Cummington Street, Boston; (mail) 16 Florence Street, Cambridge, Mass.

PROSSER, ROGER D. (M) member of firm, Thomas Prosser & Son, 15 Gold Street, New York City.

RAES, OSCAR MEDART (M) engineering, Chrysler Corp., 12800 Oakland Avenue, Highland Park, Mich.; (mail) 12411 Westphalia, Detroit.

RUMBLE, J. LANCE (A) salesman, General Motors Products of Canada, Ltd., 208 Spadina Avenue, Toronto, Ontario, Canada; (mail) 102 Dinnick Crescent.

STRIBLING, JOHN WM. (M) engineer, Anderson Mfg. Co., 195 Albany Street, Cambridge, Mass.; (mail) 2-244 General Motors Building, Detroit.

THOMSON, A. MORRIS (M) vice-president, charge, engineering, Dardelet Threadlock Corp., Suite 2135, 120 Broadway, New York City.

WAGSTAFF, WILLIAM A. (M) refrigeration engineer, charge of acoustics, Norge Corp., 606 Woodbridge Avenue, Detroit.

WHITBURN, FANCHER KERR (J) assistant purchasing agent, Chevrolet Motor Co., Oakland, Calif.; (mail) 2035—11th Avenue.

Applications Received

The applications for membership received between March 15, 1934, and April 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

BAKER, DWIGHT S., research engineer, Hyvis Oils Inc. of California, Los Angeles, Cal.

BAKER, ROBERT M., air box operator, Bendix Stromberg Carburetor Co., South Bend, Ind.

BISHOP, JOHN JOSEPH, in charge automotive equipment, New England District, Cudahy Packing Co., Boston, Mass.

BRAMHALL, LESLIE E., assistant foreman, State of California, Department of Public Works, Bishop, Cal.

CARR, GEROME BYRON, automotive superintendent, Wilshire Oil Co., Los Angeles, Cal.

CLARK, MANLEY H., western manager, Le Roi Co., Milwaukee, Wis.

CLAUSEN, CHRISTIAN E., mechanical engineer, Fairbanks, Morse & Co., Beloit, Wis.

CLOHISY, WARREN A., president, W. A. Clohisy, Inc., Chicago.

COLE, CHARLES ARNOLD, district manager, Thompson Products, Inc., Cleveland.

COLUMBUS AUTO PARTS CO., Columbus, Ohio.

EATON, BRUCE G., JR., engineer, Curtiss Aeroplane & Motor Co., Buffalo, N. Y.

GROAT, CHESTER A., president, Chester A. Groat Auto Co., Seaside, Ont., Canada.

HUBBS, EARLE, Bloomfield, Ont., Canada.

HUGHES, JACK, fleet service instructor, Chevrolet Motor Co., Detroit.

HUNT, ROBERT, assistant general superintendent of motive power, Seaboard Air Line Railway Co., Norfolk, Va.

HOSSFELD, HERBERT S., vehicular supervisor, Continental Baking Co., New York City.

LINTERN, W. A., secretary, Nicholas-Lintern Co., Cleveland.

LYON, RALPH P., special agent, Standard Oil Co. of California, San Francisco.

MARTIN, HENRY C., JR., 104 Elm Ave., Mount Vernon, N. Y.

NAPIER, CARILL S., technical director, Cirrus-Hermes Engineering Co. Ltd., Brough, East Yorkshire, England.

NICHOLSON, ARTHUR BORDEAUX, 1st Lieutenant, Coast Artillery Corps, U. S. A., Fort MacArthur, San Pedro, Cal.

PLASSERAUD, RENE, associate, Law Offices of Messrs. Weismann, Blum & Plasseraud, Paris, France.

POLLIE, HUGH H., superintendent of maintenance, Colonial Coach Lines Ltd., Ottawa, Ont., Canada.

RAMSAUR, WALTER R., research engineer, Harrison Division of General Motors, Lockport, N. Y.

RANKIN, JOHN MCLEAN, Standard Engineering, Toronto, Ont., Canada.

RITTER, W. K., JR., mechanical engineer, National Advisory Committee for Aeronautics, Hampton, Va.

STOECKEL, ROBBINS B., research associate in highway transportation, Yale University, New Haven, Conn.

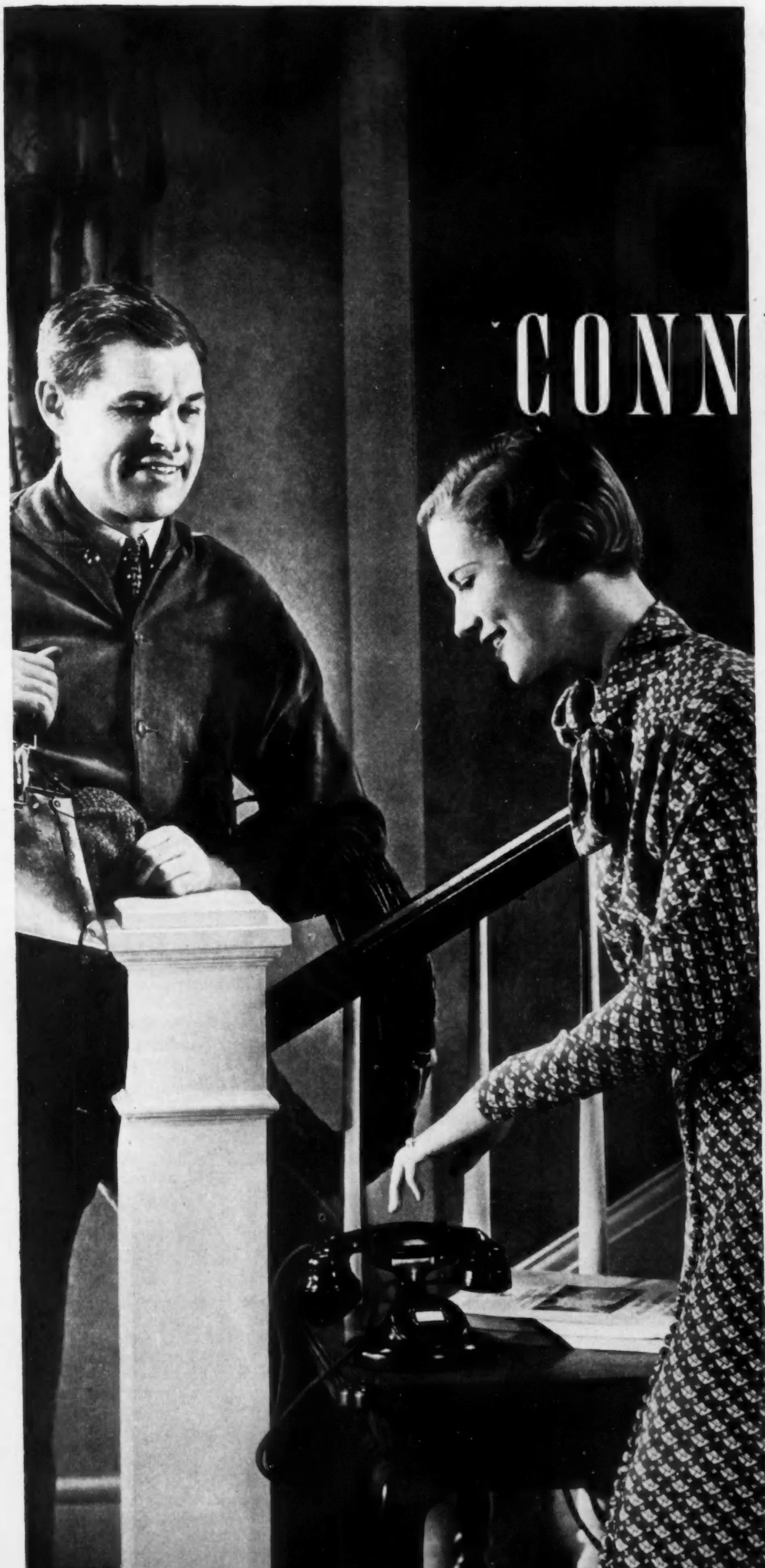
TAYLOR, HERMAN W., manager lubricating Sales, General Petroleum Corp. of California, Los Angeles, Cal.

VIANO, FRED N., vice-president and service manager, Colonial Garage Inc., Lexington, Mass.

VINTSCHGER, FRANCIS E., student, Casey Jones School of Aeronautics, Newark, N. J.

WEAVER, LEO R., draftsman, Merz Engineering Co., Indianapolis, Ind.

WILLIS, ROBERT OLIVERS, chemical engineer, Dunlop Rubber Co., Toronto, Ont., Canada.



Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Nomenclature for Aeronautics

By National Advisory Committee for Aeronautics. N.A.C.A. Report No. 474, 1933; 37 pp., including 13 figs. Price, 10 cents. [A-1]

The Aerodynamic Analysis of the Gyroplane Rotating-Wing System

By John B. Wheatley. N.A.C.A. Technical Note No. 492, March, 1934; 22 p., 6 figs. [A-1]

Aerodynamic Rolling and Yawing Moments Produced by Floating Wing-Tip Ailerons, as Measured by the Spinning Balance

By Millard J. Bamber. N.A.C.A. Technical Note No. 493, March, 1934; 8 pp., 3 figs. [A-1]

Conversion of Energy in Cross-Sectional Divergences Under Different Conditions of Inflow

By H. Peters. Translated from *Ingenieur-Archiv*, Vol. II, 1931. N.A.C.A. Technical Memorandum No. 737, March, 1934; 19 pp., 29 figs. [A-1]

Experiments with Planing Surfaces

By W. Sottorf. Translated from *Werft-Reederei-Hafen*, October 1, 1932; February 15, and March 1, 1933. N.A.C.A. Technical Memorandum No. 739, March, 1934; 25 pp., 34 figs. [A-1]

The Development of Floats and Equipment for Research in Promoting It

By Wilhelm Pabst. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 23, No. 23, December 14, 1932. N.A.C.A. Technical Memorandum No. 740, March, 1934; 12 pp., 12 figs. [A-1]

On the Electrical Method of Measuring Small Vibrations, and Its Application to the Measurement of Vibrations of Airscrew Blades

By Jûichi Obata, Sakae Morita, and Yahei Yoshida. Report No. 103 of the Aeronautical Research Institute, Tokyo Imperial University, February, 1934; 14 pp., illustrated. [A-1]

Construction Aéronautique et Sécurité

By A. Volmerange. Published in *L'Aéronautique*, February, 1934, L'Aérotechnique section, p. 9. [A-1]

A structural failure in flight seems to be the explanation for the "Emeraude" disaster. This is, in the author's opinion, a manifestation of the probability that structurally airplanes are not sufficiently strong to meet the higher stresses imposed by increased speed and power. His suggested remedies include research especially on new materials, more stringent and longer flight tests, especially at critical speeds.

Les Travaux de ouis Stipa sur les Avions à Fuselage Tubulaire

By J. Lacaine. Published in *L'Aéronautique*, January, 1934, L'Aerotechnique section, p. 3. [A-1]

An experimental airplane with a cylindrical fuselage was recently built and tested by its inventor, the Italian engineer, Louis Stipa. The article gives the results of the tests, and, more briefly, an account of the preliminary development work and tests of the propellers enclosed in the nose of the cylindrical fuselage.

(Continued on page 40)

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NOTES AND REVIEWS

Continued

ENGINES

Variable Pitch Airscrews and Variable Gears

By W. G. Jennings. Published in *The Journal of The Royal Aeronautical Society,* January, 1934, p. 2. [E-1]

The author states that his paper is confined to the aerodynamic aspects of the problem and sets forth the advantages that may be gained by substituting a variable pitch airscrew for the normal fixed pitch airscrew, and in certain cases compares the results with those given by the introduction of a variable gear airscrew.

The mechanical side of the problem is not included.

Indicator Study of SV-1570 Engine

Prepared by Ford L. Prescott. Air Corps Technical Report No. 3877, October 16, 1933; 5 pp., with tables and charts. Published by the Chief of the Air Corps, City of Washington. [E-1]

Study of Types of Vibration Possible in Aircraft Propellers, Part I and Part II

Prepared by Lt. H. H. Couch. Air Corps Technical Report No. 3891, November 20, 1933; 20 pp., illustrated. Published by the Chief of the Air Corps, City of Washington. [E-1]

The C. I. Engine as the Rival of the Petrol Engine

By C. B. Dicksee. Published in *The Journal of the Royal Aeronautical Society,* January, 1934, p. 24. [E-1]

Every service has its own particular set of requirements which result in a different value being placed on each one of the many factors which contribute toward the final result in performance. The author lists the following as the chief factors and discusses the advantages and disadvantages of the C-I. Engine as compared with the gasoline engine: weight, bulk, dependability, cost of original plant, cost of operation, cost of maintenance and adaptability.

Investigation of a Rateau Supercharger for a 700-Horsepower Airplane Engine

By Hermann Oestrich. Translated from *Automobiltechnische Zeitschrift,* August 25, 1933. N.A.C.A. Technical Memorandum No. 738, March, 1934; 15 pp., 12 figs. [E-1]

La Détonation et Quelques Problèmes Qu'Elle Pose

By Jean Pontremoli. Reprint from *La Science Aérienne,* January-February, 1934. 12 pp.; 7 illustrations. [E-1]

Some of the problems which detonation creates for the engine designer are reviewed by the author in the light of his experience with the Gnome and Rhone aircraft engine company. He summarizes the effects of detonation on engine operation, the knowledge contributed by the physicist to the understanding of the problem, and the effects of various engine design and operating features on detonation.

HIGHWAYS

Le Débit Maximum des Autostrades

By N. Bernatzky. Published in *La Technique Automobile et Aérienne,* 1st quarter, 1934, p. 25. [F-4]

Not excessively high speed, but a uniform moderate speed for all vehicles not exceeding 30 m.p.h. is required for maximum utilization of automobile highways. This is one conclusion arrived at by the author in his analysis of conditions leading to maximum movement of vehicles or tonnage on highways per unit of time. Other conclusions relate to features of automobile, motor-truck and highway design.

MATERIAL

Oxidation Lubrication and the Blending of Mineral Oils to Obtain Maximum Lubricating Value

By R. O. King. Published in the *Journal of The Institution of Petroleum Technologists,* February, 1934, p. 97. [G-1]

Experiments made using the Jakeman machine with blends and single varieties of lubricants are described which lead to the suggestion that improvement of the lubricating value of mineral oil blends should be sought for by investigating their oxidation characteristics. The experiments were made in the National Physical Laboratory with the cooperation of Mr. C. Jakeman.

(Concluded on page 42)

NOTES AND REVIEWS

Concluded

Der Mittlere Spezifische Kraftstoffverbrauch beim Motorbetrieb mit Verschiedenen Kraftstoffen

By Professor Wawrziniok. Published in *Automobiltechnische Zeitschrift,* Feb. 10, 1934, p. 74. [G-1]

A series of tests were made to determine the specific fuel consumption of three commercial engines with gasoline, blends of gasoline with various percentages of alcohol or benzol and with various percentages of both alcohol and benzol. The blends are shown to affect specific fuel consumption favorably by permitting an increase in compression ratio, the most successful in this connection being an alcohol blend.

Les Questions Métallurgique à l'Ordre du Jour dans l'Industrie Automobile

By Léon Guillet. Published in *Journal de la Société des Ingénieurs de l'Automobile,* January, 1934, p. 2522. [G-1]

The honorary president of the French society of Automotive engineers, the only representative of the automotive industry in the Academy of Sciences, and the founder, in 1900, of the Dion-Bouton laboratory noted in France for its steel research, here discusses metallurgical questions of interest in the automotive industry. His article covers conventional high-quality steels, special steels, conventional and special irons, alloys, metal plating, aging and structural defects.

MISCELLANEOUS

Anwendungs—und Belastungsmöglichkeiten eines Neuen Gleitlagers in den Abmessungen der Wälzlager

By A. Riebe. Published in *Automobiltechnische Zeitschrift,* March 10, 1934, p. 133. [H-1]

A new type of plain bearing of such dimensions as to be able to serve as substitute for roller bearings is described, examples being given of its application and load carrying capacity.

The Turning Wheel—The Story of General Motors Through Twenty-Five Years 1908-1933

By Arthur Pound. Published by Doubleday, Doran & Co., Inc., Garden City, New York, 1934; 517 pp., illustrated. [H-3]

The occasion for the writing of this volume was the twenty-fifth anniversary of the founding of General Motors Company of New Jersey in 1908. The author points out that the growth of the organization has contributed a unique chapter to American industrial history and contends that innumerable histories of nations, rulers, wars, and peoples have been published of much less significance than this story of a great industry.

Mr. Pound, by his long acquaintance with the automobile industry and his work in economics and history, is well fitted to adequately present this review.

Industrialized Russia

By Alcan Hirsch, with preface by Maurice Hindus. Published by The Chemical Catalog Co., Inc., New York City, 1934; 309 pp., illustrated. [H-3]

Dr. Hirsch, for about two years, served the Soviet government as chief consulting chemical engineer in connection with their chemical industries, and offers in his book a scientific presentation and explanation of pertinent facts about the present status of Russia's basic industries: iron and steel, chemical, fuel, petroleum, transportation, machinery, agriculture, and so forth; and gives an interpretation from the viewpoint of an American engineer of the evolution of present-day Russian industry, business, government, finance, law, living conditions, education, and religion.

A History of the National Research Council 1919-1933

Reprint and Circular Series of the National Research Council. Number 106. Published by the National Research Council, City of Washington, 1933. 61 pp. Price fifty cents. [H-3]

During the year 1932, under the direction of the Executive Board of the National Research Council, a survey of the organization of the Council was made as a basis for recommendations in regard to possible changes. As a preparation for this survey, the Committee called upon the officers of the Council and the Chairman of the several divisions for a report upon the activities of the Council since its organization upon a peace-time basis in 1919.

These articles are now issued in pamphlet form as a partial record of the accomplishments of the National Research Council, in order that the substance of the report may be brought to the attention of the scientific workers of the country.

What Members Are Doing

William T. Livermore is doing automotive development work for a group of private individuals. His address is 649 Westfield Ave., Westfield, N. J.

Karl L. Lendl is aeronautical engineer with the Douglas Aircraft Co., Santa Monica, Cal. He was formerly with the Consolidated Aircraft Corp., Buffalo, N. Y.

J. Frank Stengel has resigned from the Dictograph Products Co., Inc., and has joined the Telephonics Corp., New York City.

Clarence G. Wood, who has been consulting engineer for the Monmouth Products Co., Cleveland, has been appointed director of sales and engineering for the same company.

Paul F. Hackethal has joined the aviation division of the Lycoming Mfg. Co., Williamsport, Pa., as engineer. He was formerly chief engineer of the Smith Engineering Co., Cleveland.

Hans Fischer is consulting engineer for the Lanova Corp., Wilmington, Del. He was formerly research engineer on Diesel engines, for the Falk Corp., Milwaukee.

H. J. Saladin, formerly assistant manager of the technical division of the Standard Oil Co. (Indiana), has been made manager of the technical department.

R. E. Wilkin has been appointed manager of the automotive engineering department and assistant manager of the technical department of the same company.

L. L. Kinstler, formerly of the Budd Wheel Co., has recently joined the Kelsey-Hayes Wheel Corp. as sales engineer.

James J. Welker, parts manager, General Motors-Holdens, Ltd., Melbourne, Australia, has been assigned to the New York office of the General Motors Export Co. for a period of 6 months.

William T. Lutey is with the Kansas City Division of the Fisher Body Corp. as layout engineer.

B. D. Kunkle

F. H. Prescott

B. D. Kunkle, formerly president and general manager of the Delco Products Division of General Motors Corp., has been appointed assistant to C. E. Wilson, a vice-president of the corporation.

F. H. Prescott, formerly president and general manager of the Guide Lamp Division has succeeded Mr. Kunkle as head of the Delco Products Division.

William Fairhurst, sales manager of the Spicer Mfg. Co., Toledo, has been elected vice-president in charge of sales of the company.

Roy E. Thompson has joined the Western Gear Works, Seattle, as engineer. He was formerly a draftsman with the Grey's Harbor Pulp & Paper Co., Hoquiam, Wash.

Geoffrey H. Vallings is joint managing director of Vallings & Wadham, Ltd., Paignton, Devon, England. He was formerly chief assistant motor engineer for Shell Mex, Ltd., London.

Karl H. Nonweiler has been transferred to the Detroit office of the Shell Petroleum Corp. as sales engineer (lubricants).

J. F. Winchester, coordinator and supervisor of motor equipment, Standard Oil Co. of New Jersey, has resigned from the New Jersey State Trucking Code Authority on account of being unable to devote time to the work.

C. M. Southard has been named general sales manager of the Warner-Quinlan Co., New York City. He was formerly assistant manager of the lubricating oil department.

Ralph J. Duckworth has joined the Reo Motor Car Co. as chassis layout draftsman. He was formerly layout draftsman with the Olds Motor Works.

Hubert C. Harper is general sales manager for North End Motor Sales, Ltd., Montreal. He was assistant zone manager for General Motors Products of Canada, Ltd., at Montreal.

N. A. Pointer has resigned from the Barnet Glass Rubber Co., Melbourne, Australia, and has returned to General Motors-Holden's Ltd., South Melbourne, as chief engineer of the car division.

Frank B. Killian has been appointed chief of the automotive engineering division, export department, Socony-Vacuum Corp., New York City. For 29 years Mr. Killian was chief automotive engineer of the Vacuum Oil Co.

Meetings Calendar

S.A.E. Summer Meeting

Saranac Inn, Saranac Lake, New York, June 17-22, 1934.

Baltimore—No Meeting

Chicago—No Meeting

Metropolitan—No Meeting

New England—June 6

S.S. "Myrtle," Central Wharf, Foot of State St., Boston, Mass. Summer Cruise of 1934.

Philadelphia—No Meeting

Pittsburgh—June 5

Pittsburgh Athletic Association; dinner 6:30 P.M.

Recent Developments in Automobile Paints, Enamels and Methods—Paul Croll, technical director, Paint and Varnish Division, Pittsburgh Plate Glass Co.

Southern California—June 8

Richfield Bldg. Cafeteria; dinner 6:30 P.M.

Automotive Powered Streamline Railcars—by a representative of the Union Pacific Railroad.

Washington—No Meeting

News of the Sections

Regional Meeting at South Bend

A telegram from D. G. Roos, president of the Society, received just as this issue of the JOURNAL went to press, reported that the first of a series of regional meetings of the Society, held in South Bend, Ind., was a tremendous success, being attended by 145. A paper by Stanwood W. Sparrow, Studebaker Corp., on The Development of a High-Speed Engine, was well received, and stimulated wide discussion.

Roos and Warner Visit Pacific Coast; Five Sections Get Summary of Progress

● Denver ● So. California ● No. California ● Oregon ● Northwest

GRADUAL disappearance of the large car in favor of smaller ones was cited by Delmar G. Roos, president of the Society and chief engineer, Studebaker Corp., as "perhaps the most important basic trend" in an address on "What's Going on in the Automotive Industry". Mr. Roos spoke before the S.A.E. Club of Denver on April 30, and subsequently before the four Pacific-Coast Sections. John A. C. Warner, secretary and general manager of the Society, also spoke. [Mr. Warner's address will be found beginning on page 18 of this issue of the S.A.E. JOURNAL, and additional abstracts from Mr. Roos's address on page 211.]

Pointing out that the economic depression was only one reason for the accelerated development of smaller cars, and that high taxes, and the large number of bargains in the market were also responsible, Mr. Roos demonstrated that excellent performance and comfort achieved in small cars had contributed to their popularity. The largest part of his address was devoted to showing in some detail how various mechanical improvements contribute to better performance and riding comfort.

Some of the wild claims for streamlining are obviously not substantiated by the facts, Mr. Roos said. The engine remains the biggest factor in performance and great strides have been made in its development with the help of the petroleum industry, which has made generally available fuels with a knock-rating minimum of 70 octane.

After describing in detail the evolution of a specific engine in power and torque, Mr. Roos went on to discuss other points in passenger-car development.

Manufacturers are taking off free-wheeling, or making it optional, he said. It is a question whether manufacturing economy or public reaction motivates this tendency.

A number of devices, like the automatic transmission may come into the economic picture when money is more plentiful, but nothing extreme in transmissions is likely to happen in the near future. A transmission that shifts on speed alone is basically unsound, according to many engineers, he said. Torque as well as speed must be taken into consideration.

There is a definite and desirable trend toward power brakes, Mr. Roos pointed out. Research has resulted in more uniform brake linings; iron-alloy drums, with steel backing-plates, have given better strength and wearing qualities.

It is possible to go a long way in improvement of riding quality by the use of suitable springs, shock absorbers, weight distribution and general suspension, and it will be two or three years before the suspension problem is worked out. Independent wheel-springing does accomplish advantages in riding comfort. In certain installations, however, big problems have come from such phenomena as axle roll, large vertical movement, steering-geometry puzzles, etc.

The conventional front axle has an advantage and characteristic which some independent front suspensions miss, that is, constant camber of the wheels on a curve. With certain independent-wheel types, and under certain conditions, the camber varies in such a manner with body roll as to make it difficult and uncertain in negotiating curves.

Proper weight distribution is another method of achieving superior riding characteristics. By moving the engine forward and putting more weight on the front springs it is possible to get an improved ride, provided that the front springs are made stiffer. But this may bring other problems in its train in the shape of handling on turns, if the engine is far forward and the center of gravity high.

Body ventilation is being improved, Mr. Roos pointed out, and there is a tendency toward greater roominess in even the smaller cars. The public is getting the greatest motor-car values in the history of the industry—but the margin of profit is "dangerously low".

The automotive engineer is doing his part to help the automotive industry to lead the country out of the depression.

In commenting on the introduction of new devices on automobiles, Mr. Roos summarized by saying "We have to take the public by the hand and lead them down the road of progress. We can't expect to throw them off a springboard. Manufacturers are now counting more upon the engineer to assist in according with this condition and in putting the companies in their proper place on the economic map."

Met. Section Tests 1934 Models

An old custom of the Metropolitan Section, dating with a few interruptions from about 1910, was carried out May 17, when members and guests of the Section participated in a field day, during which virtually all the 1934 automobiles were driven over a "proving ground" laid out at the Glenn Curtiss Airport, Jackson Heights, N. Y.

Cars were furnished by dealers and factory branches in the New York area, and an unofficial check revealed that only two brands were missing.

About 200 persons attended the tests. In the evening the Section heard "A Critical Study of Car Design and Performance," by Austin M. Wolf.

Butane and Gasoline Compared as Fuels

● Chicago

IN order to break even on fuel costs when using butane, it will be necessary that this product be available at approximately 10 per cent less than the cost of gasoline, according to D. P. Barnard, research department, Standard Oil Co. (Indiana), who presented a paper on "Butane vs. Gasoline as An Automotive Fuel" to the Chicago Section on April 3.

Mr. Barnard stated that the use of butane as a highway fuel in place of gasoline, started on the West Coast where apparently it was available in appreciable quantities and where it was being put to no particular use. Evidently the assumption was made that this material was virtually valueless at the refinery and should either be given away or at least sold at a very low price and, consequently, some very rapid developments in the conversion of truck fleets to use this fuel took place. In his subsequent discussion of the subject, he developed the possibility of the general use of butane in this class of service.

Comparing butane with other possible fuels, Mr. Barnard mentioned that it must be handled and stored under considerable pressure and that its specific gravity is quite low compared with the other petroleum fuels. Further, that its optimum explosive limits in terms of per cent of vapor by volume in the mixture is definitely higher than in the case of other fuels. One other outstanding characteristic of butane is its high knock-rating, which is well up toward 100 and above that of any other generally used fuel.

Presenting explosive mixture-ratio data expressed in the terms ordinarily employed in

Big Turnouts at Western Meetings

BEGINNING April 30 with a visit to the S.A.E. Club of Denver, D. G. Roos, president of the Society, and John A. C. Warner, general manager, completed a program of personal contacts with far-Western divisions of the Society which included the Southern California Section (Los Angeles, May 3), the Northern California Section (San Francisco, May 7), the Oregon Section (Portland, May 9) and the Northwest Section (Seattle, May 11).

***At Denver*, 75 persons turned out, although there is no formal Section there. Elmer J. Graham, superintendent of transportation, Public Service Co. of Colorado, acted as chairman. Several members of the Society, resident in Denver and vicinity, gave a dinner in honor of Messrs. Roos and Warner before the general meeting, which was held in the auditorium of the Public Service Co.**

***At Los Angeles*, the attendance was 75, and Mr. Roos's speech was reported as being received with standing applause. In the discussion which followed W. Hall, Charles H. Paxton, C. V. Elliot, C. H. Jacobsen, and W. E. Powelson took a prominent part.**

Vice-Chairman George H. Mosel opened the meeting at *San Francisco* in the absence in the East of Chairman Evans. During the dinner which preceded the meeting Mr. Roos was presented with a deed to 1000 acres of prunes in Pruneville, for "his future enjoyment during visits to California, when his active life has ceased and he shall have taken up residence in the Santa Clara Valley as the highest point of worldly ambition." Attendance at the San Francisco meeting was 62.

***At Portland*, the meeting was the largest in the history of the Oregon Section, being attended by 176 persons. A feature of the meeting was an exhibition of material collected by the Section for presentation to the engineering school of Oregon State College. H. W. Drake, Section chairman, presided at the meeting.**

***The Seattle* meeting was the last of the season for the Northwest Section and was attended by 200 members and guests. Sherman Bushnell presided.**

The gist of Mr. Roos's speech to the several Sections appears on the opposite page.

In connection with Mr. Warner's address motion pictures of mechanized equipment developed by the Ordnance Department, U. S. Army, were shown. The films were lent through the courtesy of Col. C. M. Wesson.

A series of slides illustrating various phases of early S.A.E. and automotive activity were also shown where time and the facilities permitted.

automotive practice, Mr. Barnard noted that butane forms mixtures slightly leaner than ordinary fuels on a weight basis. When these mixture ratios are converted into *gallons* of fuel necessary to make operating mixtures with a given volume of air, it is obvious that the lighter fuel shows up to a very decided disadvantage. This volumetric consumption disadvantage amounts to over 20 per cent when compared with motor gasoline and must be overcome before actual realization of the benefits of higher compression and better volumetric efficiency than are possible with gasoline.

Mr. Barnard noted also that, in spite of the 30 per cent possible increase in brake mean effective pressure and a reduction in specific fuel consumption of 15 per cent as compared with the representative values for current practice with motor gasoline, butane still shows up to a disadvantage when fuel consumptions are considered upon a volumetric basis. It would appear, therefore, that the only possibility in using butane for highway service, granting that the ultimate price of the fuel delivered to the consumer is not greatly below that of gasoline, would lie in improved performance of the equipment under certain driving conditions, thus reducing the necessity for gear shifting and thereby lowering the average swept engine-volume for a unit of distance of more than 8 per cent. It does not appear at this time that this possibility exists, he said, particularly in the Middle West, although it may be that some such effect as performance improvement has been of influence in the observations reported on the West Coast.

At present, Mr. Barnard remarked, it appears that any attempt to supply butane under the conditions necessary for highway units would eventually result in a final cost to the operator on a gallonage basis higher than that prevailing for regular gasoline. Actually, in his opinion, if there is any advantage to be gained in the improvement of performance of existing vehicles, aviation gasoline of the fighting-grade type would appear to be a more attractive ultimate possibility than butane.

It would seem to Mr. Barnard that one very real possibility for the economic use of butane as an internal-combustion fuel should exist in railway service for such equipment as high-speed rail-cars and, possibly, switching locomotives. In the case of the former, it is quite desirable to secure large power-outputs along with smoothness of operation and reasonably light weight. At the same time it is also desirable to avoid multiplicity of units such as would be required in case outputs of the order of 1000 hp. are to be attained with conventional gasoline engines. For example, for this class of service there should be a demand for a moderately light-weight powerplant of from 800 to 1000 hp., which at the same time must operate at as low fuel costs as possible. The use of butane should greatly facilitate the design of a new engine. As to the requirements for switching-locomotive service, it is necessary to have available for immediate use a relatively large amount of stand-by power. Two butane-burning engines might therefore be installed in the rail car, the reserve engine being kept at normal operating temperature by interlocking of the cooling systems.

In conclusion, Mr. Barnard said in part that it does not appear that butane can be adapted economically to use in small units, particularly for highway service, as it does not offer appreciable cost advantages under these conditions. Butane possesses some disadvantages in addition to those of cost; in particular, that of fire risk, as the handling of such material under pressure definitely increases the hazard over that of handling gasoline. Further, all of the butane carbureting systems which have been devised up to the present time depend upon the vapor pressure of the fuel itself for their functioning. At 20 deg. fahr., the vapor pressure of commercial butane is less than atmospheric, and this requires the use of auxiliary starting equipment such as the installation of a gasoline carburetor for cold-weather starting-purposes.

Further, Mr. Barnard stated that it should be borne in mind that the amount of butane which can be economically recovered in the course of present refinery and natural-gasoline-plant operations is definitely limited, and that no very widespread use of the material as a fuel could occur without increasing the demand to a status where cost would be prohibitive.

Wolf is Speaker On Oil Problems

● Indiana

Dr. Harry Wolf, General Motors Research Corp., was the speaker at the April 19 meeting of the Indiana Section. His paper on "Automotive Lubrication Problems with Special Reference to Winter Standards" contained a portion of advance data to be presented at the Summer Meeting, and was illustrated with slides showing results of research on lubrication especially cold-weather starting and operating.

The meeting was attended by 125 members and guests and was preceded by a dinner attended by 63. At a business meeting held in connection with the session on motion of Louis Schwitzer, seconded by Charles Merz, it was ordered that the secretary prepare a memorial resolution to be spread on the records in appreciation of the life and section activity of the late Franklin F. Chandler, former section chairman and nationally known in Society activities.

Section Sponsors C. E. Wilson In Joint Meeting With C. of C.

●Pittsburgh

"AN important thing in connection with any business enterprise and especially with a business intending to make materials in volume is to recognize that the obsolescence of a plant or a process is a physical fact and not a matter of bookkeeping. If you have obsolete plants or equipment, the sooner you recognize the fact and let your engineers figure out what new equipment should be installed to produce better and cheaper products, the more your business will flourish."

The speaker was Charles E. Wilson, vice-president in charge of accessories divisions, General Motors Corp., and the setting an overflow meeting of the Pittsburgh Chamber of Commerce, for which the program was arranged and participated in by the Pittsburgh Section of the Society.

Listening at the speakers' table were Alex Taub, research engineer, Chevrolet Motor Co.; George A. Davidson, president Pittsburgh Aviation Industries; Ex-Governor Fisher of Pennsylvania, president of the Pittsburgh Chamber of Commerce; Dr. Thomas S. Baker, president, Carnegie Institute of Technology; A. W. Robertson, chairman of the board, Westinghouse Electric & Mfg. Co.; William P. Witherow, president, Witherow Steel Co.; S. M. Kintner, vice-president, Westinghouse; and Murray Fahnestock, chairman of the Pittsburgh Section, who gave a short introductory address.

Prominent Men Present

Prof. Willibald Trinks, Carnegie Institute, and a founder-member of the Pittsburgh Section, introduced the speakers.

John A. C. Warner, secretary and general manager of the Society, was among those present, as were Walter S. Peper, chairman of the Metropolitan Section; A. L. Humphrys, chairman of the board, Westinghouse Air Brake Co.; and C. A. Rowan, president of the same organization.

The meeting was held April 19, and Mr. Wilson's speech was broadcast over station WCAE of Pittsburgh.

Excerpts from Mr. Wilson's speech follow:

"The average car and truck production for the ten-year period, 1924 to 1933 inclusive, for cars produced in the United States and Canada and cars exported from this country was 3,591,364. The average production for the first quarter during this same ten-year period was 925,087 automobiles. During the first quarter of this year the industry produced 751,937 cars, which is 81½ per cent of the average production of the ten-year period. Perhaps we could say that we are 80 per cent or a little more of what we may call normal. During this ten-year period the maximum production was 5,621,715 and the minimum production in the year 1932 was only 1,431,494 or 25 per cent of the maximum.

Industry Spends Millions

"During this past year the automobile industry has spent millions of dollars in engineering programs and for new tools to bring out more attractive cars and make the users over the country dissatisfied with their old models and want to spend their money for new ones. We believe that this has been a constructive thing to do for the country and also for our business.

"If you compare one of the moderate-priced automobiles that would probably be delivered to your home for $750 with anything else that you can buy for the same money, you will feel well satisfied with the value of the $750 automobile.

"One of the things that has happened in the industry, which I feel sure will be interesting to you men who are suppliers, has been the trend of the industry to the so-called low-price field. Six or eight years ago 57 per cent of the cars produced sold for less than $825, or were in what we call the low-price field. More than 25 per cent of the automobiles produced were in the upper-medium price field, selling from $1175 to $2000. Buicks, Studebakers, Nashes, Hudsons, fell in this classification at that time. Since that time the trend of the business has been more and more to the lower-priced cars for two or three reasons: with the improvement in our roads the smaller cars were more satisfactory; with the improvement in the riding qualities of the smaller cars they rode as well as the heavier and more expensive ones; the performance and carrying capacity of the lower-priced cars were improved to where they were just as satisfactory to the user as the higher priced automobiles.

"In the year 1933, 87½ per cent of all cars produced were in this low-price field and only 2.13 per cent were in the upper-medium-price field, which formerly accounted for 25 per cent of the industry. The registrations for 25 states for March show 92.47 per cent of all cars sold to be in the lower-price field and only 1.7 per cent of the cars in the upper-medium-price field. These figures are interesting to any one studying the possible market for materials and parts. They also indicate a continuing trend to the low-price field.

"During the low production year of 1932, the employment situation in Detroit was very bad. A great many men were out of employment and the depression, coupled with the ordinary seasonal unemployment that we strived hard to avoid, centered a great deal of interest in the Detroit unemployment problem. In April, 1929, there were 450,000 hourly workers in the automobile industry in the Detroit metropolitan area. At the low point in September, 1932, there were 99,000 and in February, 1933, there were 96,000. April 1 of this year there were again 360,000 employed. We think that on April 15 there are 372,000 employed. The 372,000 figure is almost exactly the same as the employment in October, 1929, and in May, 1930.

"Detroit is again the optimistic business city, which those of us who have known Detroit for the last 20 or 25 years have been familiar with. While the number of people employed in the district is not quite up to the 1929 peak we feel that the number employed in the automobile industry is as great today as it was in 1929. The remaining unemployment is really in the capital goods industries of Detroit.

1933 Output Was 2,000,000

"The total number of cars produced in 1933 was slightly over 2,000,000 and together with the service parts and service equipment used in the industry had a total wholesale value of $1,655,000,000. The best estimate we can make is that at least half of this money, or $800,000,000, is spent for material and parts outside of the definite automobile manufacturing area, which we might say is within 100 miles of Detroit.

"While the automobile business as such has centered around Detroit, our present modern automobiles have only been made possible by the cooperation of many engineers and of many business concerns.

"I have a few figures here on the consumption of the automobile industry of various raw materials. The industry uses 80 per cent of the rubber used in America, 38 per cent of the plate glass, 15 per cent of the iron and steel, 14 per cent of the lumber and hardwood, 11 per cent of the copper, 10 per cent of the lead, 25 per cent of the aluminum, 28 per cent of the nickel, 85 per cent of the gasoline, and 59 per cent of the lubricating oil. The Pittsburgh industries produce all of these things.

"Recently in this country we seem to have somewhat mixed our social and economic thinking. Engineers have been criticized for developing new things. Factory executives have

C. E. Wilson, vice-president of General Motors, before the microphones at a Pittsburgh Section Meeting April 19. At the left of the picture is Dr. E. A. Baker, president of the Carnegie Institute of Technology and, at the right, Murray Fahnestock, chairman of the Pittsburgh Section. The meeting at which Mr. Wilson spoke was arranged by the Pittsburgh Section, and held jointly with the Pittsburgh Chamber of Commerce (●Pittsburgh)

been criticized for developing new machinery with which a man could produce four, five, ten times as many parts with the same physical effort. Engineers and industry have been blamed for unemployment, due to the rapid development of improved machinery, without taking into account the increased market due to the increased consumption of lower cost goods.

"Personally, I am convinced that the only reason that we have the relatively high scale of living that we have in this country is on account of our progressive business methods and our technological development. I do not think an engineer needs to hang his head in shame because he has taken a large part of the physical burden from the backs of labor, because he has made it possible for the average family in this country to have all the fine things that they have and the better things they can have in the future.

"I am looking forward myself to a time which I do not think is very far distant, when we can have a better scale of living in this country than we had in 1928 or 1929. I have never been able to understand the theory of improving our scale of living in this country by restricting production. I am sure that we will find that whatever measures we have found necessary along this line will only be temporary. It seems to me that it is very clear that when we slaughter hogs to make fertilizer, some one who would like to have bacon for breakfast is going to go without. And when we pay farmers for plowing up cotton, some one who would like to have a new shirt is going to have to wear his old one.

"I am sure we will find the same thing about our industry. We are not going to have to go to any thirty-hour week to re-employ the workmen in our plants and our factories. By increasing the average scale of living and the consumption of goods, all who are willing to work can be employed at reasonable working hours. This is my hope and firm belief."

Northup and Vidal Share Big Meeting

● Detroit

Amos E. Northup, chief body designer, Murray Corp., and Eugene L. Vidal, director of aeronautics, Department of Commerce, were the speakers at a "general interest" meeting held by the Detroit Section on April 16. The meeting was largely attended and was reported to be one of the most enthusiastic of the season. Mr. Vidal's topic covered past and future work of the aeronautics branch in the promotion of air commerce and Mr. Northup talked about "Future Streamlining".

"So many more possibilities present themselves at each new development", said Mr. Northup, "that the danger of every car being designed by mathematical formula is more remote than ever."

He indicated that he was in favor of the design which places the passengers between the wheels rather than over the rear axle.

"If this method is adopted by other companies," he said, "it will mean a new basis on which to work. It gives designers new zeal for doing some further development work on the rear of the car—it can be treated by aerodynamic principles much more easily than the present styles.

"Continuation of progress already made toward a more streamlined car lies with the fenders. It is apparent that they must be blended with the body and not designed as mudguards.

"With the step of blending fenders with body

Here is an item of current automotive interest which was received from C. J. McFarlane, an active member of the Society, located in far-off Calgary, Canada. The picture was taken, Mr. McFarlane writes, in Moose Jaw, Saskatchewan, and shows a popular mode of travel in western parts of Canada. He suggests that it helps to explain the question as to where old cars go.

comes serious thought to the whole front end. Looking at a present front end we are immediately conscious of radiator, two fenders, two lamps and the bumper. Eventually this will be worked out as a whole. When we look to the front end of the car that is coming toward us we will be aware only of an ensemble into which have been worked fenders, radiator and lamps. It would serve its purpose just as efficiently as at present—perhaps more so—but will present a uniformed appearance. The bumper will be so designed and presented as to blend into this front end ensemble."

In the past Mr. Vidal pointed out in his address, the aeronautics branch of the Department of Commerce has been conducted to regulate air commerce and to provide aids to air navigation.

On the assumption that the success of commercial aviation depends on its becoming a real business, rather than a subsidized stepchild of the Federal government the aeronautics branch is working on a program which not only assists in this respect but which could change America's attitude toward air and air transport.

Discussing scheduled air transport, he said, "regulations covering the interstate transportation of the public by scheduled air lines cannot be relaxed in any way. If anything, these requirements will tend to become even more stringent. Any revisions will have increased safety as their goal.

"In order that our commercial transport systems may be economically independent every air line must earn a profit in carrying passengers, mail and express so that each may employ its surplus for essential and continuous development. The science of aviation improves rapidly and hence expensively. Air lines must increase their passenger revenues and lower their costs, and, I believe that it is the government's duty to assist in both needs."

Truck Design Problem Described by Gwynne

● St. Louis

How design problems were overcome in evolving the White 12-cyl., horizontal engine was told the St. Louis Section at its April 19 meeting by George R. Gwynne, transportation engineer, The White Co.

Why the dry-sump principle was used and why many other innovations were necessary were pointed out in the course of Mr. Gwynne's paper. Particularly stressed were the precautions the designers had taken to assure faithful performance and long life. Points discussed were illustrated by photos which were passed out by the speaker.

How older vehicles that may not be able to keep up with today's traffic streams may have their performance considerably improved was also touched upon. Changes in rear-axle ratios, transmission ratios and tire equipment could greatly affect performance it was shown. Many of these changes could be accomplished at comparatively little expense when balanced against the improvements obtained. When changeovers from solid to pneumatic tires were made it was frequently possible, Mr. Gwynne said, with the expenditure of a few more dollars to improve greatly the acceleration and economy of operation of the vehicle.

The meeting was attended by 24 members and guests of the Section, and was preceded by a dinner for the governing board and speaker.

Amendments to Constitution

At the March 14, 1934 Council meeting, the following amendments to the By-Laws were presented in writing.

At its April 25th meeting, these amendments were adopted by the Council in accordance with paragraph C58 of the Constitution. The amendments follow:

Amendment to B-35—Proxies

The following paragraph to be added:

"An elected officer or a member elected to fulfill a certain definite duty cannot delegate this authority."

Amendment to B-31—Meetings

First paragraph to be changed to read as follows:

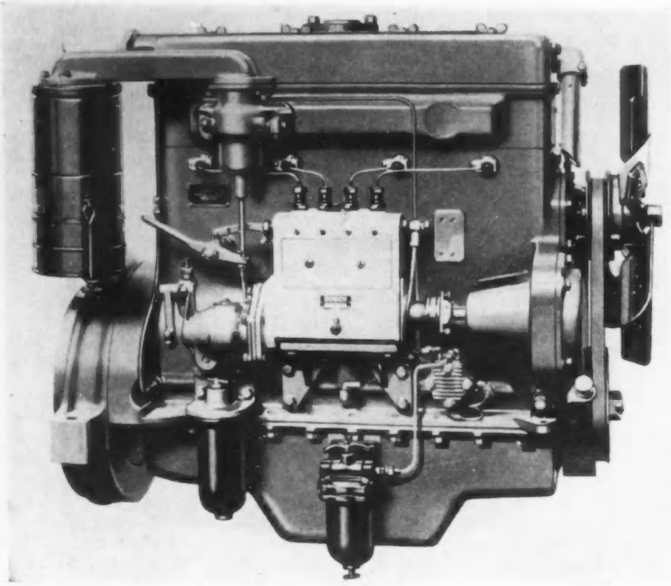
"The Annual Meeting of the Society shall be the first regular meeting of the calendar year, and the Semi-Annual Meeting shall be the second regular meeting of the calendar year. The Council shall designate one session of each meeting as a Business Meeting, and shall announce its decision in a publication of the Society published at least ten days prior to the meeting. If the Council does not designate any session as a Business Session, the first session of the meeting shall be a Business Session."

Second paragraaph as at present.

Amendment to B-20—Publication Committee

B-20 to be changed to read as follows:

"The Publication Committee or its duly authorized representatives shall review all papers and discussions which have been presented at the meetings of the Society or its Sections, and decide what papers or discussions, or parts of same shall be printed in the publications of the Society and what shall be omitted. The Committee will be expected to publish all such data from the material submitted, as will be of assistance to engineers and investigators in their work, in so far as the finances of the Society permit."



Pump-side view of the VIKH Waukesha-Hesselman engine. The engine is started on gasoline supplied to the manifold by a conventional primer pump. It operates satisfactorily on No. 2 or No. 3 furnace oil after the starting period. A paper by A. W. Pope, Jr., Waukesha Motor Co., described the engine at a Chicago Section Meeting April 3. Some excerpts from the paper appeared in the May issue
● Chicago

Holds Dinner Meeting In College Town

● Oregon

A special dinner meeting was held at Salem, May 18, by the Oregon Section. Prof. S. H. Graf, Oregon State College, spoke on "The Theory of Combustion". Other speakers were W. H. Paul, whose subject was "Scientific Carburetor Adjustment", and Dewey C. Rohloff, who spoke on "Practical Application of the Air-Fuel Ratio Analyzer". Chairman Drake presided at the meeting which was attended by 38 members and guests, 17 of whom made the trip from Portland.

The meeting was a phase of the Oregon Section's recently revived student activity at the Oregon State College and the purposes behind this activity were discussed by Mr. Drake at the meeting.

Discussion of the technical papers was contributed by R. G. Brady, Valley Motor Co.; Derl Marks, Marks Electric Co.; S. C. Schwarz, Refining Industries, Inc.; Verne Savage, Portland Municipal Shops; and Douglas McKay of the McKay Chevrolet Co.

Geschelin and Paul Divide a Program

● Baltimore

The paper by Joseph Geschelin, engineering editor, *Automotive Industries*, on "Cab Over Engine Trucks" was presented to a meeting of 51 members and guests of the Baltimore Section on May 3. The paper had been presented previously by Mr. Geschelin at a meeting of the Metropolitan Section on April 19. Changes suggested by the discussion which followed the Metropolitan Section presentation were incorporated in the paper before its presentation at Baltimore.

Walter Paul of Ralph Stark, Inc., Long Island City, New York, was the second speaker on the Baltimore program. His subject was "The Science of Welding."

Dinner preceding the meeting was attended by 42.

Section Resumes Student Activity

● Oregon

Resumption of the Oregon Section's student activity for Oregon State College was celebrated May 9 at a Section Meeting attended by President Roos and General Manager Warner. Previous to the meeting the Oregon Section sent out a call for automotive materials and equipment for the use of the college. The response was overwhelming. Gifts were received from the following companies: Portland Traction Co., reconditioned yellow bus 6-cyl. Knight engine; Oregon Parts Co., 3 engines, 4 transmissions, 5 differential assemblies, 7 steering gears; Refining Industries, 1 barrel oil; Sunset Electric Co., generators, starters, distributors, carburetors; Tracy & Co., distributors, carburetors; Winfield Carburetor Agency, carburetors; The White Co., manifolds; Markworth Gear Co., piston rings; F. J. Howatt Co., radiator cores; Stevens & Rathkey, carburetors and batteries; Mallory Electric Co., electrical equipment; The Cronin Co., cylinder hone and tools; Lathan & Co., zenith carburetors; Moores Motor Sales, Franklin parts; Marks Electric Service, electrical equipment; Francis Motor Co., Lincoln parts; Allen Battery Co., batteries; Emsco Sales Co., pistons and brake lining; Jadson Motor Products Co., valve guides, valves, valve seats; Plomb Tool Co., tools; The Standard Oil Co. furnished transportation to move all materials to Oregon State College; Campbell Auto Towing furnished transportation to move the heavy engines to and from the hotel.

The gifts were received on behalf of the Oregon State College by Professor Graf, director of engineering research. Just before the presentation was made President Roos added a Studebaker President 8-cylinder engine to the list of donations and after the meeting The Refining Industries donated a requisition good for reasonable quantities of all grades of lubricants manufactured by it. On the subject of the Section's participation in student activity a resolution was adopted as follows:

"To assist as much as is physically possible, enrolled student members of the Society of Automotive Engineers who are residents within the geographical boundaries of the Section, and furthermore to offer annually to said students a suitable prize or prizes for the best technical papers concerning automotive and aeronautical subjects written by said student members and presented to the Section's activity committee on or before Feb. 15 of each year. These papers to be judged by rules which shall be written immediately by the committee and submitted to the governing board for approval."

Three silver cups were given to the section to be used as student prizes. The donors were: M. E. Vandewater, The Refining Industry, 1st prize; Ed. Grenfell, Meier & Frank Co., 2nd prize; and Julius Zell, Zell Bros., 3rd prize.

Armstrong Reviews Seadrome Project

● Washington

Edward R. Armstrong, president and general manager, Armstrong Seadrome Development Co., Wilmington, Del., was the speaker at the May 2 meeting of the Washington Section which was attended by 75 members and guests. Mr. Armstrong's topic was "Floating Airports on the High Seas" with special reference to the Armstrong proposal for transatlantic airways.

Motion pictures were shown of the construction and test of the model Seadrome and demonstration models of the Seadrome and its anchorage system were exhibited.

Tractor Meeting Approaches 200

Attendance approached 200 at the S.A.E. National Tractor and Industrial Power Equipment Meeting held at the Hotel Pfister, Milwaukee, April 18 and 19, according to an analysis of the registration made after the meeting.

Members and guests were present from 13 states. Society status of those present and registering was as follows:

Guests	101	51.5
Members	86	44.0
Reserve Members	7	3.5
Students	1	0.5
Applicants	1	0.5
	196	100.0

The territorial representation was as follows:

	Number Attending	Per Cent of Total Attendance
Wisconsin	95	48.5
Illinois	47	24.0
Michigan	16	8.3
Ohio	14	7.2
New York	5	2.5
Iowa	4	2.0
Missouri	4	2.0
Indiana	3	1.5
Minnesota	2	1.0
Oklahoma	2	1.0
Washington, D. C.	2	1.0
New Jersey	1	0.5
California	1	0.5
	196	100.0

Wide Attendance Greets Canton Outing

● Cleveland

What was characterized as the most successful and enjoyable outing in years was held May 18 by the Cleveland Section. The Timken Roller Bearing Co., Canton, Ohio, was host to 250 members and guests of the Section, including 35 from the Detroit area.

The Timken plant at Canton was visited in the morning. A Dutch lunch was held at noon and in the afternoon, golf, baseball and tennis matches were run off at the Brookside Country Club. A dinner at the club was held in the evening. More than 200 golf players went over the Brookside links.

The committee arranging the outing included T. V. Buckwalter, Ernest Wooler, Guy Waters, W. Sanders and E. Austin.

H. H. Timken, president, and chairman of the board, Timken Roller Bearing Co., in welcoming the guests, made an address in which he asked the younger Society members to refuse to grow old or get old ideas for their industry. Chairman Howard replied to Mr. Timken, expressing appreciation of his company's hospitality.

As a result of the sports activities the baseball championship cup was won by a Canton team defeating a Cleveland Section team. Golf prizes awarded by Mr. Buckwalter went to A. T. Colwell for low gross score and to James Ayling for medal play. Some of the other prize winners were George Sprowls, R. Jones, H. Benjamin, E. A. Parkhurst and Ray Spiller. The bridge drive was won by Woolsen, of Timken. Ferdinand Jehle won the prize for the worst golf drive.

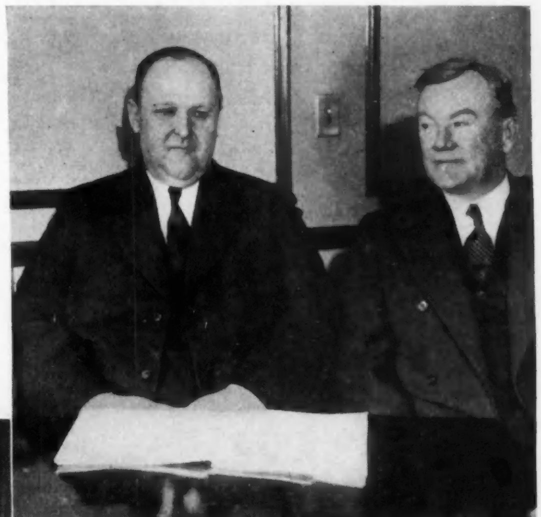
(Continued from page 23)

little disturbance throughout the general system of numbering as possible. A. L. Boegehold, General Motors Corp., was named chairman. Other members were, B. H. De Long, Carpenter Steel Co. and J. B. Johnson, Wright Field.

Members of the Division were of the opinion that the Division should develop specifications in such manner as to meet the technical requirements of its membership and the users, and that if users' experience indicates the economy of limits that are narrower than standard under the code as now approved, such limits should be maintained and the code authorities should make fair and equitable adjustment of price extras.

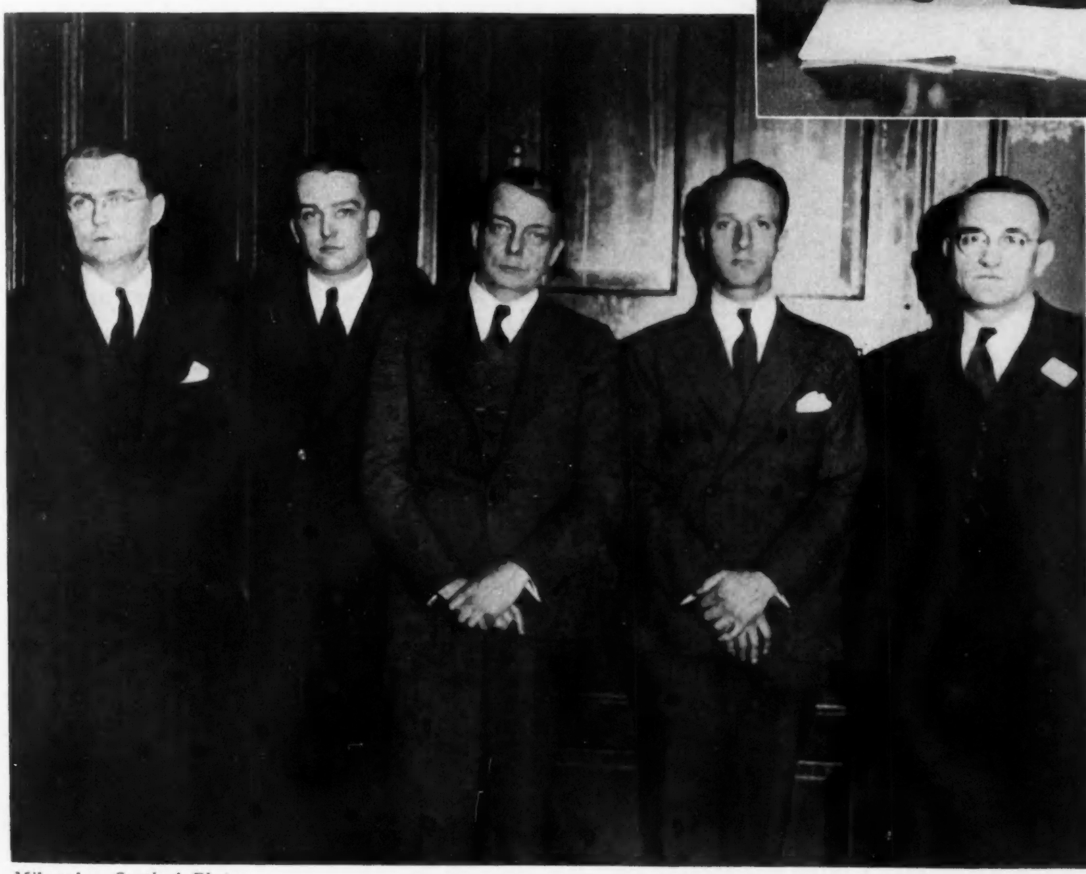
Another meeting of the Iron and Steel Division was held May 21 and 22 in Detroit. Several subdivisions reported, and a full agenda of new and old business was gone through.

Prominent at Tractor Meeting



***(Right)* H. C. Merritt, general manager, tractor division, Allis-Chalmers Mfg. Co.; and M. H. Pettit, Oliver Farm Equipment Co., were active in discussing papers presented at the S.A.E. National Tractor and Industrial Power Equipment meeting held in Milwaukee, April 18 and 19**

Wisconsin News Photo



Milwaukee Sentinel Photo

***(Left)* H. H. Howard, Caterpillar Tractor Co.; C. G. Krieger, Ethyl Gasoline Corp. and chairman of the National Tractor Committee; J. B. Fisher, Waukesha Motor Co.; Fowler McCormick, International Harvester Co.; and E. R. Jacoby, Continental Motors Corp. Messrs. Howard, McCormick and Jacoby presented papers to the meeting and Messrs. Krieger and Fisher were chairmen of sessions.**

National Tractor and Industrial Power Equipment ● Meeting ●

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between April 10, 1934, and May 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Beebe, Murray C., (J) testing department, Pratt & Whitney Aircraft Co., Hartford, Conn.; (mail) 26 Mansfield Terrace, Middletown, Conn.

Crawford, Vincent E. (A) vice-president, general manager, Thompson Products, Ltd., South Street, St. Catharines, Ontario, Canada.

Crowley, John P. (A) salesman, Linde Air Products Co., 30 East 42nd Street, New York City; (mail) 2001 Commonwealth Avenue, Brighton, Mass.

Dillon, John W. (A) purchasing agent, International Harvester Co. of Canada, Ltd., Sherman Avenue, North, Hamilton, Ontario, Canada.

Edwards, Allen F. (A) president, treasurer, Universal Products Co., Inc., 6455 Kingsley Avenue, Dearborn, Mich.

Halford, Andy (A) superintendent, L. L. Adcox Trade School, 237 Northeast Broadway, Portland, Ore.

Hall, E. G. (A) salesman, Canada Wire & Cable Co., Ltd., Box 518, Toronto, Ontario, Canada.

Hamilton, Samuel A. B., Jr. (M) automotive instructor, Fort Worth Vocational School, Fort Worth, Texas; (mail) 2010 Gould Avenue.

Hazard, Schuyler, Jr. (M) sales engineer, Seaman Paper Co., 2867 East Grand Boulevard, Detroit.

Hoenicke, Edward C. (A) sales manager, Eaton-Erb Foundry Co., 9771 French Road, Detroit.

Kasper, W. F. (M) vice-president, charge of engineering and sales, Fairmont Railway Motors, Inc., 410 North Main Street, Fairmont, Minn.; (mail) 814 Albion Avenue.

Lozano, Reynoldo (A) representative, Continental Motors Corp.; Continental Automobile Co., Mexico City, Mexico; (mail) Barcelona 5A.

Mackie, J. C., Major (F M) inspector, mechanical transport, Royal Army Service Corps, British Army, Regent's Park Barracks, Albany Street, London N. W. 1, England.

McCombs, Stuart C. (A) vice-president, charge of oil seal sales and manufacturing, Chicago Rawhide Mfg. Co., 9000 Alpine Avenue, Detroit.

Miller, Robert F. (A) sales engineer, Noblitt-Sparks Industries, Inc., East 17th Street, Columbus, Ind.; (mail) 11 McLean, Apartment 227, Detroit.

Motion, Robert (J) service station manager, Standard Oil Co. of N. J., Newark, N. J.; (mail) 1 Woodside Road, Madison, N. J.

Peters, Melville Fuller, Dr. (S M) physicist, Bureau of Standards, City of Washington.

Piquerez, Emile (F M) president, Tecalemit, 18 Rue Brunel, Paris, France.

Prutton, C. F. (M) associate professor, chemical engineering, Case School of Applied Science, Euclid Avenue at East Boulevard, Cleveland.

Rianhard, James Lincoln (A) general sales, Standard Oil Co. of N. J., Baltimore, Md.; (mail) 1008 Winding Way, Roland Park.

Shimer, William B. (J) student engineer, Schwitzer-Cummins Co., 1125 Massachusetts Avenue, Indianapolis; (mail) 3248 Washington Boulevard.

Simpson, John (J) clerk, service man, master mechanic, Oliver United Filters, Inc., 33 West 42nd Street, New York City; (mail) 2115 Linden Street, Ridgewood, L. I., N. Y.

Smith, Robert Sidney (A) front axle technician, Bendix Service Corp., 5750 Cass Avenue, Detroit; (mail) 7405 Pilgrim Avenue.

Taylor, D. W. (A) lubrication engineer, Seaside Oil Co., Summerland, Calif.

Tzannetakis, George Panagiotis (FM) flight lieutenant, Greek Air Ministry, Athens, Greece.

Winkelmann, Otto (F M) test engineer, Adler-Werke, Frankfurt A/M, Germany; (mail) Savignystr. 78.

Applications Received

The applications for membership received between April 15, 1934, and May 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Adamson, N. Frederic, assistant chief engineer, Twin Disc Clutch Co., Racine, Wis.

Burroughs, Kenneth L., instructor in aeronautics, Aeronautical University, Chicago.

Churchill, W. W., superintendent of equipment, Washington Motor Coach System, Seattle, Wash.

Coverley, Robert Henry, experimental production engineer, Rolls-Royce Ltd., Derby, England.

Dahlman, Gustave R., engineer, The Skinner Chuck Co., New Britain, Conn.

Darby, Robert Alan, student, Massachusetts Institute of Technology, Cambridge, Mass.

Ensign, R. O., parts and service manager, American Austin Car Co., Inc., Butler, Pa.

Estabrooke, John C., student, New York University, Bronx, N. Y.

Hamilton, Daniel E., automotive representative, Ethyl Gasoline Corp., New York City.

Hubbard, John R., Captain, Quartermasters Corps, U. S. Army, War Department, Washington, D. C.

Intemann, Hermann Kolle, engineer, Halowax Corp., New York City.

Kamey, Emil, engineer, Standard Motor Products, Inc., Long Island City, N. Y.

Kynoch, Charles W., research engineer, Chrysler Corp., Detroit.

Lauck, Alfred W., 13 Long Drive, Hempstead, N. Y.

Livingston, Irwin Douglas, tool maker, Saco Lowell Textile Mfg. Co., Biddeford, Me.

Long, Leighton M., metallurgist, Bunting Brass and Bronze Co., Toledo, Ohio.

Marks, Earl A., owner of Earl Marks Electric Service, Portland, Ore.

Pamplin, Douglass G., 1st Lieutenant, U. S. Army, Fort McClellan, Ala.

Pappas, Costas Ernest, graduate student, New York University, New York City.

Reggio, Ferdinando Carlos, experimental engineer, Compagnie Lilloise de Moteurs, Paris, France.

Richardson, Walter Edward, Canadian sales manager, A. C. Spark Plug Co., St. Catharines, Ont., Canada.

Roberts, Walter A., designing engineer, Lanagan & Hoke, Inc., Philadelphia.

Rybkin, Ivan Z., engineer, designer, Stalin Automobile Plant, Moscow, U.S.S.R.

Snyder, Clifford L., sales engineer, L. A. Young Spring & Wire Corp., Detroit.

Snyder, John S., lecturer, The Aeronautical University, Inc., Chicago.

Standard Motor Products, Inc., Long Island City, N. Y.

Stryker, Clinton E., chief engineer, Fansteel Products Co., Inc., No. Chicago, Ill.

Tatsuye, Y., assistant engineer, Tokio Gasudenki Co., Tokyo, Japan.

Thorp, George Boulton, instructor, aeronautical engineering, Carnegie Institute of Technology, Pittsbugrh, Pa.

Tiedemann, Carl, engineer, Aeronautical University, Inc., Chicago.

Tijken, Robert, 81 Bilderdijklaan, Rijswijk ZH, Holland.

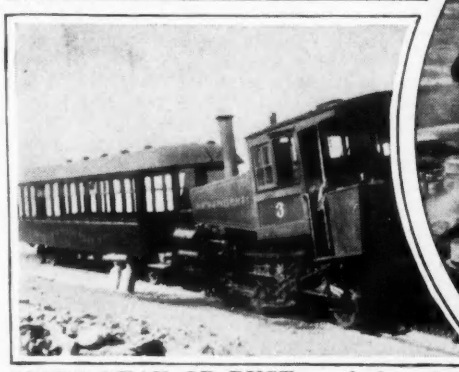
Trump, Frederick O., mechanical engineer, 233 Pondfield Road, Bronxville, N. Y.

Walsh, Thomas E., president, Walsh Advertising Co., Ltd., Windsor, Ont., Canada.

Wrenn, John Joseph, sales engineer, The Autocar Co., New York City.

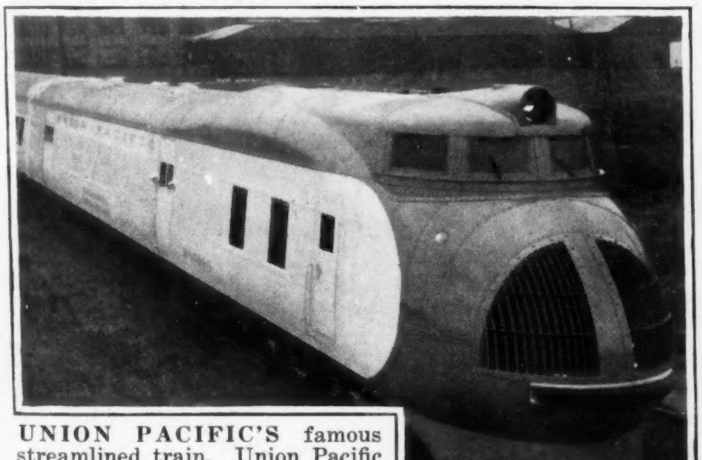
1½ BILLION GALLONS!

SINCLAIR TANK CARS LOADING at one of the 8 great Sinclair refineries. Sinclair sells 1½ billion gallons of products annually. Crude oils are brought to Sinclair refineries both by tank car and by pipe line. The Sinclair pipe line system is the longest pipe line system in the world. It embraces 7,000 miles of trunk lines and an extensive gathering system with a capacity of 200,000 barrels of crude oil a day.



PIKE'S PEAK OR BUST—and they don't bust. Mountain-climbing locomotives on the Manitou & Pike's Peak Railway have been Sinclair-lubricated for eleven years.

THE SINCLAIR DINOSAURS symbolize the vast age of the crude oils which are refined into Sinclair lubricants. Sinclair is almost the only refining company which has access to the oldest crudes in all three of the great producing areas of the United States.



UNION PACIFIC'S famous streamlined train. Union Pacific has contracted for complete Sinclair lubrication of this equipment east of Ogden, Utah. This includes engine, car journals, air conditioner, lighting apparatus, etc.

OIL BOOTLEGGERS FOILED. Sinclair Motor Oils are now dispensed from Tamper-Proof cans at no extra price. These cans are sealed at Sinclair refineries and opened before the motorist's eyes—an air-tight guarantee against substitution.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Effect of the Surface Condition of a Wing on the Aerodynamic Characteristics of an Airplane

By S. J. DeFrance. N.A.C.A. Technical Note No. 495, April, 1934; 3 pp., 6 figs. [A-1]

Full-Scale Drag Tests of Landing Lamps

By C. H. Dearborn. N.A.C.A. Technical Note No. 497, May, 1934; 5 pp., 4 figs. [A-1]

Problems Involving the Stiffness of Aeroplane Wings

By H. Roxbee Cox. Published in *The Journal of The Royal Aeronautical Society*, February, 1934, p. 73. [A-1]

An aircraft may reasonably be said to be structurally safe if it is known that during the manoeuvres which it is likely to perform (a) the stress in no part of the essential structure approaches the failing stress of the material, and (b) it does not become unstable or uncontrollable on account of structural distortion. This is the context which the author sets down on which to discuss wing structure of the airplane. The problem of wing stiffness is analyzed in its relation to prevention of wing-flutter, prevention of loss of lateral control, prevention of wing distortion in flight, and airplane stability. The paper also includes notes on the calculation of wing stiffness, and the effect of torsional stiffness on strength calculation.

Tail Buffeting

By W. J. Duncan. Published in *The Journal of The Royal Aeronautical Society*, February, 1934, p. 108. [A-1]

The author points out that as a result of the findings of the Accidents Investigation Sub-Committee of the Aeronautical Research Committee and its expression of opinion that tail buffeting was the probable primary cause of an accident to a Junkers monoplane at Meopham, Kent, England, an intensive study of buffeting was undertaken in England and Germany and somewhat later in United States with the result that this phenomenon is quite well understood, and methods for its avoidance have been established.

The present paper gives a general account of the investigations on this subject conducted at the National Physical Laboratory in recent years, together with references to work outside of England.

The Calculation of Lateral Stability with Free Controls

By Gotthold Mathias. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 23, Nos. 7 & 8, April 14 and 28, 1932; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 741, April, 1934; 44 pp. [A-1]

Supplemental Data and Calculations of the Lateral Stability of Airplanes

By Gotthold Mathias. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, Nos. 19 & 20, Oct. 14 and 28, 1933; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 742, April, 1934; 25 pp., 8 figs. [A-1]

International Index to Aeronautical Technical Reports

Prepared by The Society of British Aircraft Constructors, Ltd. Published by The Royal Aeronautical Society, London, 1934; 131 pp. [A-3]

This Index contains references to British and foreign reports, memoranda and articles on technical aeronautical subjects which have mainly appeared during 1932.

(Continued on page 36)

NOTES AND REVIEWS

Continued

Hazards to Aircraft Due to Electrical Phenomena—Report of Special Committees on Hazards to Aircraft Due to Electrical Phenomena

N.A.C.A. Technical Note No. 494, March 1934; 6 pp. [A-4]

Genauigkeit von Höhenbeobachtungen mit Periskopsextanten

By Gustav Forstner. Published in *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Dec. 28, 1933. [A-4]

Tests made both on the ground and in flight to determine the accuracy of a periscope sextant, in the construction of which a compass has been incorporated, are described.

EDUCATION

Les Informations du B.I.E.T.

Published by Bureau International de l'Enseignement Technique, Paris, France, January, 1934. [D-1]

The International Bureau for Technical Education in this, its second bulletin, reports on the condition of the organization, outlines the program for the next international meeting to be held May 17-19, 1934, and summarizes the status of technical education in several European countries. Future bulletins may be translated into several languages.

ENGINES

A Preliminary Motion-Picture Study of Combustion in a Compression-Ignition Engine

By E. C. Buckley and C. D. Waldron. N.A.C.A. Technical Note No. 496, April, 1934; 8 pp., 4 figs. [E-1]

Possible Future Developments of Air-Cooled Aero Engines

By A. H. R. Fedden. Published in *The Journal of The Royal Aeronautical Society,* March, 1934, p. 169. [E-1]

Mr. Fedden reviews the present stage of air-cooled aircraft engine design and outlines the probable trend of development during the next ten to fifteen years. The paper is comprehensive and the author expresses the hope that it will stimulate discussion.

Deposits and Corrosion in the Cooling System

By E. A. Smith. Published in *The I. A. E. Journal,* May, 1934, p. 29. [E-1]

The author discusses the thermal balance of the water cooled engine; thermal transmission in the engine; the radiator functioning; the formation and effect of deposits in the cooling system and radiator; the nature of deposits; corrosion; and remedial treatment for deposits and corrosion.

HIGHWAYS

Traffic Safety Survey of Cambridge, Massachusetts

Conducted by the Governor's Committee on Street and Highway Safety. Published in mimeograph form by the Governor's Committee, State House, Boston, Mass., 1934; 133 pp. [F-1]

The report covers a thorough survey of the motor vehicle accident problem of Cambridge, Mass., with recommendations for remedial measures. The following phases of the problem are considered: Motor Vehicle Accident Facts; Motor Vehicle Law Enforcement; Traffic Engineering; Traffic Regulations and Safety Education.

Street Traffic Bibliography

By The Erskine Bureau for Street Traffic Research, Harvard University. Published in mimeograph form by Harvard University, Cambridge, Mass., 1933; 223 pp. [F-3]

This volume is a selected and annotated bibliography of the literature of street traffic control and related subjects 1920-1933, prepared and published under a grant of the Harvard University Committee for research in the social sciences from the funds of the Rockefeller Foundation.

Although based primarily upon traffic control activities, the bibliography gives attention to such related problems as planning and taxation.

MATERIAL

Causes of Detonation in Petrol and Diesel Engines

By G. D. Boerlage and W. J. D. Van Dyck. Published in *The I. A. E. Journal,* April, 1934, p. 11. [G-1]

Many types of detonation may be distinguished, and the causes are to be found in the engines as well as in the fuels, the authors point out, adding that obviously one single cause would not be expected to be found, but, on the contrary, quite a number of properties which will be more or less of influence under different engine conditions. These may differ widely, yet the authors show that there is more unity in the multitude of causes of detonation than might be expected.

(Concluded on page 38)

NOTES AND REVIEWS

Concluded

and put forth the view that it is correct to look at the phenomena of combustion in Diesel engines and in gasoline engines from the same aspect.

Knocking Characteristics of Aromatic Hydrocarbons

By Wheeler G. Lovell, John M. Campbell, Frank K. Signaigo, and T. A. Boyd. Published in *Industrial and Engineering Chemistry*, May, 1934, p. 475. [G-1]

The relative tendencies to knock in an engine were measured for fifty-nine hydrocarbons embracing the aromatic series. These measurements were made not on the hydrocarbons alone, but in admixture with gasoline; the results are expressed, as in previous work, using the antiknock effect of aniline as the standard of comparison.

Upon this basis, the authors state, there appear great differences among the knock properties of these compounds. Certain relationships between colecular structure and the knocking properties of these compounds are consistent with similar relationships previously observed among paraffins, olefins, and naphthenes.

Fatigue Strength of Airplane and Engine Materials

By Kurt Matthaes. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 24, Nos. 21 & 22, Nov. 4 and 28, 1933; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 743, April, 1934; 31 pp., 20 figs. [G-1]

Guayule Rubber in Tires and Tubes

By J. H. Doering. Published in *Industrial and Engineering Chemistry*, May, 1934, p. 541. [G-1]

In the experiments reported tires and tubes were made in which the rubber used was exclusively guayule. These were of the 4.50 x 21 size and were tested in Florida over a period of 2 years. These tires failed at mileages between 8500 and 10,500 because of tread wear. The inner tubes gave satisfactory service throughout the duration of the test.

The problems connected with the development and processing of the compounds are discussed, and the formulas are given.

Peroxides in Gasoline—Effects of Peroxide Formation in Cracked Gasolines

By J. C. Morrell, C. G. Dryer, C. D. Lowry, Jr., and Gustav Egloff. Published in *Industrial and Engineering Chemistry*, May, 1934, p. 497. [G-1]

Peroxides were formed in controlled amount in four representative cracked gasolines, two treated and two untreated. The oxidized gasoline was analyzed, and from part of it the peroxides were removed by percolation through fuller's earth. Comparison was then made of the octane number, gum content, and induction period of the original, peroxidized, and regenerated gasolines, with and without inhibitors. It was found that, as the peroxides are increased, the copper-dish gum, whether measured with or without an inhibitor, is increased, and octane number and induction period are reduced.

PASSENGER CAR

Wege der Deutschen Kraftfahrt im Spiegel der Deutschen Autoschau Berlin 1934

By W. Ostwald. Published in *Automobiltechnische Zeitschrift*, March 15, 1934, p. 151. [L-1]

Technical progress outshining that of many recent years marks the 1934 Berlin automobile show, reports the author, who then points out the most significant features of this advance. Other articles in this show issue describe the exhibits.

Wesen un Zweck der Stromlinienform

Published in *Automobiltechnische Zeitschrift*, Feb. 25, 1934, p. 82. [L-1]

The character and method of development of a scientifically streamlined body are described in this article, the leading article in an issue devoted to the Jaray streamlined body. The topics of the other articles are power consumption calculations with especial reference to streamlined bodies, the ventilation, heating and cooling system of the Jaray body, its past history, newest models, advantages and patent history.

Vier Jahre Kraftfahrzeugabsatz

By Cornelius Castorp. Published in *Automobiltechnische Zeitschrift*, March 10, 1934, p. 121. [L-6]

Sales of automotive vehicles in Germany for the last four years are analyzed. Separate charts are presented for passenger cars, commercial vehicles and motorcycles, showing the sales figures for each month as divided between domestic and foreign products. Sales figures for each of the more important makes for the total period are also given. Some factors affecting the sales are mentioned.

News of the Sections

New England Takes a Cruise

On June 6, 149 members and guests of the New England Section boarded the S.S. Myrtle for the second annual summer cruise.

The cruise began at 9 in the morning and lasted until 6 in the evening. A business meeting was held in the morning and after that the members fished, danced and ate their way through what was reported to be a very successful affair.

Pre-Race Meeting Draws Big Crowd

● Indiana

About 375 persons attended the May 24 meeting of the Indiana Section which was characterized as a pre-race meeting and featured Lee Oldfield, consulting engineer, as speaker. The meeting, which is an annual affair in advance of the Memorial Day Race at the Indianapolis Speedway, was attended by a number of racing pilots. Among them Joe Russo, Wilbur Shaw and Russell Snowberger participated in discussion.

Mr. Oldfield drew on his long experience with racing cars to show that when properly prepared they can operate up to 75 per cent of full throttle with maximum fuel economy. Limitation to 45 gal. of fuel carried by cars participating in the 1934 race was meant to cut down excessive speed in the early stages of the race. Mr. Oldfield showed that the entire race could be run on 45 gal. of fuel with no diminution of average speed for the 500 miles.

Louis Schwitzer, president, Schwitzer-Cummins Co., Indianapolis, and a member of the technical committee for the race, and Herman E. Winkler, Mr. Schwitzer's assistant, followed on the program and commended Mr. Oldfield for his study of fuel economy and fuel efficiency in past races. H. M. Jacklin, of Purdue University, and Roy W. Paton, Perfect Circle Co., joined in the discussion which followed.

Stout Talks About Automotive Opportunity

● Canadian

"Automotive Opportunities in Transportation" was the subject chosen by William B. Stout, president, Stout Engineering Laboratories, Dearborn, Mich., who was the speaker at the final meeting of the season for the Canadian Section, held May 16. Mr. Stout pointed out that in order to maintain our position in the march of progress we must work on facts rather than opinions. The present-day point of view changes each year and we are adding daily to the sum of human knowledge an amount that our forefathers took a year to accumulate.

The fundamental in the creation of wealth is velocity, he said, at one time thrift meant putting pennies in a savings bank, but today it means putting them to work and having them returned quickly so that they may be sent out on another venture.

Mr. Stout maintained that the automobile industry has raised the standard of mankind and developed a new type of man through its system of specialized production. It has enabled the untrained man to earn a good wage with which he could not only raise his own standard of living but also provide higher education for his children so that when their turn came they could enter on an even footing a struggle for survival in a society with a heightened material standard.

The meeting was attended by 125 members and guests of the Section. A report of the membership committee showed that the membership of the Section had increased from 94 to 187 during the year, due partly to an enlargement of the Section's territory by including also 44 members added by natural increase.

J. L. Stewart, chairman of the Section during the 1933-34 season, was presented with an engraved loving cup in appreciation of his efforts as chairman.

An invitation from the Buffalo Section for members of the Canadian Section to visit them at their next meeting was well received.

Winther Discusses Railcar Developments

● Chicago

M. P. Winther, railcar engineer, Pullman Car & Mfg. Corp., told the story of "Light-Weight and High-Speed Passenger Train Development" at the May 1 meeting of the Chicago Section, attended by 68 members and guests of the Section. Discussion of Mr. Winther's talk was led by E. E. Adams, vice-president of the Pullman Co., and included a broad range of questions from those present.

Retiring Chairman Nutt in a brief speech thanked the members of the Section for their interest and attendance during the 1933-34 season and expressed his appreciation to the governing board and committees for their cooperation.

Winther Repeats Railcar Talk

● Milwaukee

At the Milwaukee Section meeting on May 16, attended by 65, M. P. Winther, of the Pullman Car & Mfg. Corp., repeated his talk given at the Chicago Section on May 1.

Discussion of Mr. Winther's talk centered on fuels and their suitability for use on railroads. Gasoline, butane and distillate were considered. It was said that the probable trend would be toward Diesel engines for railroad use because of fire and explosion hazards in tunnels.

Naegel Describes Commercial Bodies

● Philadelphia

"The Field of Light-Weight Construction of Commercial Bodies" was the subject covered by William C. Naegel, chief engineer, Bender Body Co., Cleveland, at the May 9 meeting of the Philadelphia Section.

Mr. Naegel described in detail the advantages of using wood, steel and aluminum-alloy materials for body construction. Wood was originally used on account of its being the only material available at reasonable cost. It was later displaced by steel because of the heavy weight required for a given strength. At the present time aluminum alloys are replacing steel for the same reason. This lighter weight construction permits higher pay-load.

The author had many slides showing beam and post construction, Dural-wood-steel body construction, commercial trailer bodies, aluminum-foil insulation and dump trucks used at Boulder Dam.

During the discussion Mr. Clever of the American Stores pointed out that not enough thought had been given to designing bodies so that they would withstand high wind, high deceleration due to braking and bumps obtained when attempting to park close to an unloading platform. He also pointed out that metal floors were not satisfactory as they proved to be slippery during wet weather.

Others who discussed Mr. Naegel's paper were Charles O. Guernsey, chief engineer, J. G. Brill Co., and Messrs. Van Horn of the Edward G. Budd Mfg. Co. and McKennan, of the Aluminum Co. of America. Total attendance at the meeting was 90.

Progress in Air Shown by Thaden

● Kansas City

H. V. Thaden, aeronautical engineer, Transcontinental & Western Air, presented a paper on "Modern Air Transport" at a Kansas City Section meeting on May 11. The dinner held by the Section was followed by an inspection trip through the shops, hangar, offices, test rooms, etc., of the T.W.A. base, at North Kansas City, Mo. Among the airplanes viewed were the new Douglass Transport and the Northrup Gamma, a speed mail plane which recently completed a Los Angeles to New York trip in 11 hr. 15 min.

The meeting at which Mr. Thaden spoke was to have been a combined meeting of the

Wichita and Kansas City Sections. Owing to bad flying weather, only two members of the Wichita Section were able to be present. The total attendance at the meeting was 19.

Surface Finishes Surveyed by Croll

● Pittsburgh

Paul R. Croll, director of research of the Paint & Varnish Division, Pittsburgh Plate Glass Co., journeyed from Milwaukee to give a talk on "What's New in Enamels, Lacquers and Methods of Application" at the June 5 meeting of the Pittsburgh Section. The meeting was attended by 60. An active discussion was conducted by B. H. Eaton of the Bell Telephone Co. Among many who participated in the discussion were John M. Orr., Equitable Auto Co.; Joseph Harvey, Pttsburgh Motor Coach Co.; H. S. Heichert, Pittsburgh Plate Glass Co.; Charles R. Noll, Gulf Refining Co.; and R. K. Beamer.

Herreshoff Tells Of Sailing Ways

● Detroit

About 310 members and guests attended the closing meeting of the season for the Detroit Section, which was held at the Detroit Yacht Club, May 28. The speaker of the evening was Alexander G. Herreshoff, assistant chief engineer, Chrysler Motor Corp., who talked about "The Past, Present and Future of Sailing Boats." With Mr. Herreshoff boats are a hobby, but he told also something about the work of his father, N. G. Herreshoff, who is a celebrated designer of racing yachts. The paper was largely historical and dwelt on the "human-interest" phases of the subject.

C. F. Kettering, vice-president of General Motors Corp., was toastmaster of the meeting. He gave a talk on Diesel-engine development at the Winton Engine Co. plant with particular reference to two-cycle Diesel engines for railcar work.

Many Members Attend Dinner of A. P. Sloan

Harold Nutt, chairman of the Chicago Section represented the Society and the JOURNAL at a dinner sponsored by Alfred P. Sloan, Jr., president, General Motors Corp., in Chicago, May 25. The dinner featured "Previews of Industrial Progress in the Next Century" and was attended by about 400 leaders in the political, industrial and intellectual life of the United States. Dinner was held in the Hall of Progress, General Motors Building at a Century of Progress in Chicago.

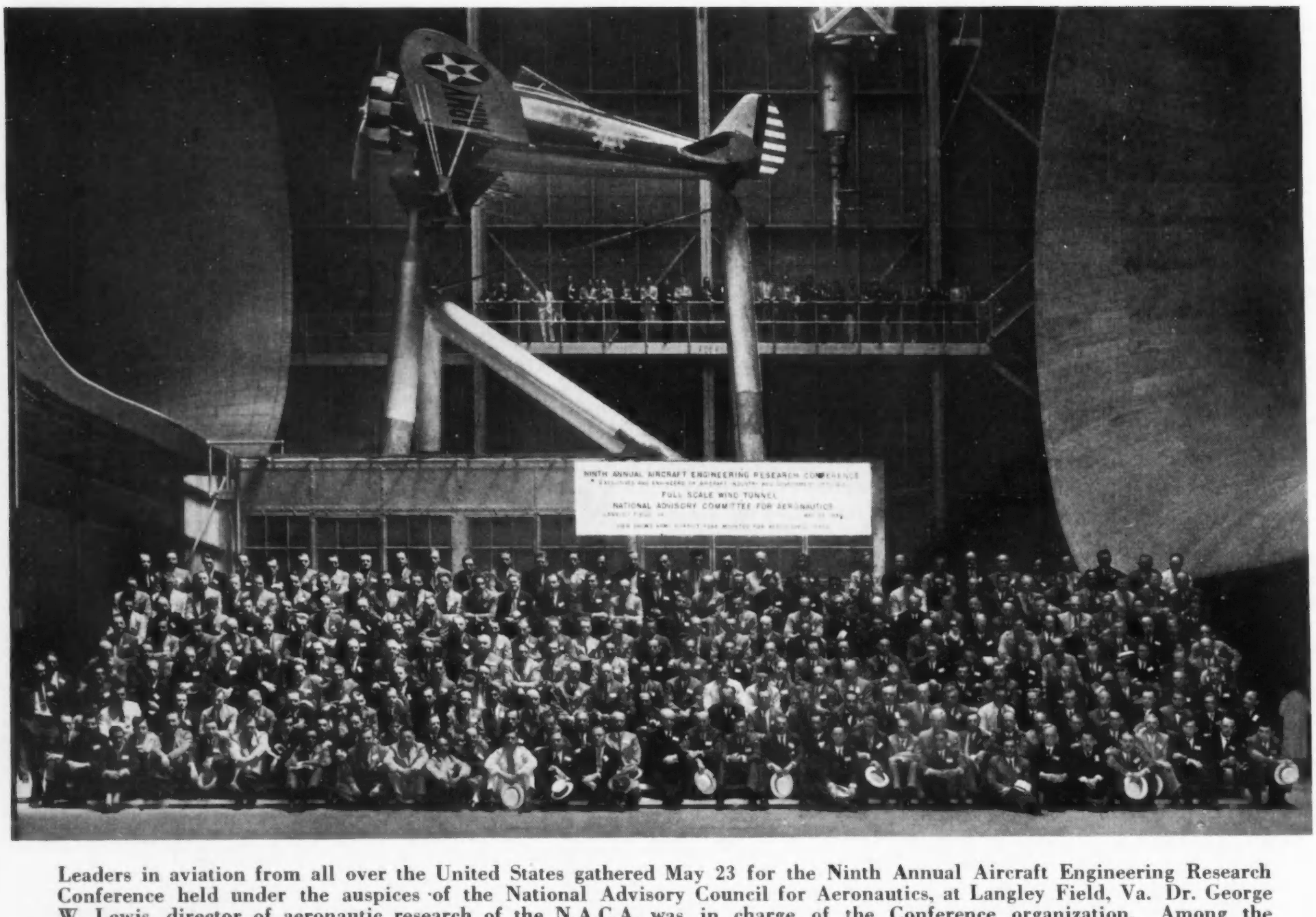
Charles F. Kettering, head of the General Motors Research Corp., was toastmaster and Robert E. Wilson, vice-president, Standard Oil Co., of Indiana, was among the eight speakers who gave "previews" of the next century of progress. Lowell Thomas, radio commentator, who appeared on the S.A.E. Summer Meeting program introduced many of the speakers.

In welcoming his guests Mr. Sloan extolled the progress of the past century particularly of the past two decades. He said that he anticipated progress in the future at an accelerated rate but that this can best take place when artificial barriers recently erected are removed. "There is no progress or accomplishment," he said, "in the school of thought which maintains that we will have more by producing less. We must never be satisfied with a status-quo condition."

Mr. Wilson described some of the possibilities of the newly discovered "heavy water" which is contained in ordinary water but has a different hydrogen balance. Freezing at 39 deg. fahr. instead of 32 deg. fahr.

In speaking of the undreamed treasures held in solution by sea water, Mr. Wilson mentioned the Ethyl-Dow bromine recovery plant. As an example of how applied science has made possible the extraction of treasures once regarded as unobtainable.

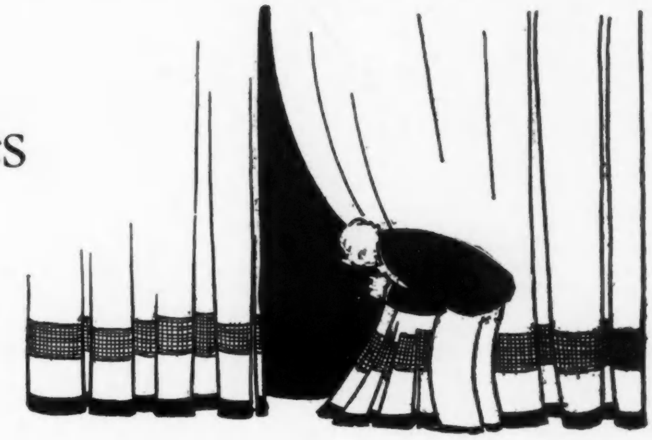
Among the members of the Society who were present at Mr. Sloan's dinner were: W. H. Beal, Vincent Bendix, F. A. Bower, C. J. Brukner, A. J. Fisher, Lawrence P. Fisher, Ralph E. Flanders, O. E. Hunt, William S. Knudsen, B. D. Kunkle, Alvan Macauley, C. L. McCuen, Leonard V. Newton and H. H. Timken.



Leaders in aviation from all over the United States gathered May 23 for the Ninth Annual Aircraft Engineering Research Conference held under the auspices of the National Advisory Council for Aeronautics, at Langley Field, Va. Dr. George W. Lewis, director of aeronautic research of the N.A.C.A. was in charge of the Conference organization. Among the many other S.A.E. members who attended were T. P. Wright, vice-president representing aircraft engineering, and Robert Insley, vice-president representing aircraft-engine engineering. Three past-presidents of the Society—Dr. H. C. Dickinson, E. P. Warner, and Henry M. Crane—were also among those present. The photograph shows the members of the Conference grouped in front of the full-scale wind tunnel of the N.A.C.A. A U. S. Army P 26A pursuit plane is mounted for testing.

Behind the Scenes

With the Committees



Gasoline Engine Testing Forms

A SURVEY is being completed among manufacturers of gasoline engines to determine whether revisions are required in the standard gasoline-engine test forms of the Society. The forms will be reprinted and such revisions as made with general approval will be incorporated in the new forms.

Safety Glass

AN official definition of the term Safety Glass was adopted at the first meeting of the Sectional Committee of the Safety Code for Specifications and Methods of Test for Safety Glass —Z 26, held in New York, May 28. The Sectional Committee is working under American Standards Association procedure and was sponsored by the National Bureau of Casualty and Surety Underwriters and the Bureau of Standards.

The Safety-Glass definition is as follows: "Safety Glass shall be construed as meaning glass designed to reduce or minimize

the likelihood of personal injury from flying glass when the glass is broken."

The Sectional Committee adopted a resolution submitting the above definition for safety glass to the National Conference on Street and Highway Safety, which had adopted recommendations during the previous week, on this material.

It was voted also to appoint a subcommittee —Z 26.1 of approximately 11 members to be appointed from among the following groups: glass manufacturers (2), plastic manufacturers (2), purchasers (3), including one from the bus-operating industry. The public, governmental agencies, independent specialists and insurance interests (each 1).

This subject has been considered by the Passenger Car Division of the Society's Standards Committee for some time because of the increasing use of such glass in motor vehicles, and the number of states that are requiring its use. The Division itself will not work on this subject for the time being, or until it is evident that some phase of standardization for automotive use desired, that may not be embodied in the Sectional Committee's report. The Division is planning, however, to organize an automobile advisory subdivision to cooperate with Subcommittee —Z 26.1 through the S.A.E. representatives.

The Society's official representatives on the Sectional Committee are Passenger-Car Division Chairman George McCain, H. B. Haskins, W. H. Graves, H. C. Mougey, and R. S. Burnett as alternate.

Transmission Drives for Speedometers

A SURVEY is being made among transmission and speedometer manufacturers and other interested organizations to determine sentiment in favor of establishing a uniform standard for speedometer drive gears and dimensions at the rear end of the transmission gear box of motor vehicles. The returns to date indicate general approval of such a project.

Iron and Steel Standards

A SECOND meeting of the Iron and Steel Division of the Standards Committee was held May 21 in Detroit. A recommendation that the American Society for Testing Materials specifications and charts for classifying grain size should be used in connection with S.A.E. and structural steels was approved for review by the Standards Committee and the Council. Nine groups of S.A.E. steel specifications definitions and tests were reviewed and a number of detailed changes were made. Appointment of eight subdivisions and an editing committee were confirmed.

Storage Batteries

AT the time of the Annual Meeting of the Society last January there was approved for publication, general information covering methods and equipment required for testing storage batteries. This was intended for the general information of storage battery manufacturers and users.

The Electrical Equipment Division of the Standards Committee has prepared general specifications on storage batteries, location of battery parts, type designations and markings, terminal posts and dimensions. Motor-truck batteries and motorcoach batteries are covered also.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between May 10, 1934, and June 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

AGRILLO, HENRY F. (A) mechanic, Great Eastern Stage, 331 Nevins Street, Brooklyn, N. Y.; (mail) 507 Eighth Avenue.

ATKINSON, JOSEPH HERBERT (A) factory sales representative, Pittsburgh Plate Glass Co., 6045 Hamilton Avenue, Detroit.

BENGE, FRANK H. (M) development engineer, Continental-Diamond Fibre Co., Newark, Del.; (mail) 444 South Phillip Street, Detroit.

BLEISTEIN, WALTER S., DR. (M) consulting engineer, patent attorney, 15 Park Row, New York City.

BURWELL, ARTHUR WARNER (M) vice-president, technical director, Alox Chemical Corp., Buffalo Avenue and Iroquois Street, Niagara Falls, N. Y.; (mail) Post Office Box 949.

BUSSE, RALPH L. (A) vice-president, charge of sales, Timken-Detroit Axle Co., 100-400 Clark Avenue, Detroit.

CODE, ALFRED REGINALD (F M) chief automotive engineer, Vacuum Oil Co., Pty., Ltd., 29 Market Street, Melbourne, Victoria, Australia.

COLUMBUS AUTO PARTS CO. (Aff.) Hudson Street and P.R.R., Columbus, Ohio; Representative: Klages, R. E., president, general manager.

DE BEAUBIEN, WILLIAM J. (J) engineering draftsman, Pontiac Motor Co., Pontiac, Mich.; (mail) 82 Murphy Avenue, Apartment 3.

EATON, P. W. (A) shop foreman, Consolidated Freight Lines, 21st and Quimby Streets, Portland, Ore.; (mail) R. 1, Box 27A, Estacada, Ore.

EDWARDS, FRANK GILLARD (M) proprietor, Chilliwack Garage, Chilliwack, B. C., Canada.

FREEMAN, WALTER R. (M) automotive engineer, Wagner Electric Corp., St. Louis, Mo.; (mail) 831 Westgate.

GILBERT, GROVER D. (M) motor vehicle supervisor, Illinois Bell Telephone Co., 1531 West Harrison Street, Chicago.

GILDEE, JOHN J. (M) sub-master, head, automotive mechanics department, Lowell School Department, Lowell Vocational School, Broadway, Lowell, Mass.; instructor, automotive engineering, Massachusetts Department of Education, Division, University Extension, State House, Room 217, Boston; (mail) 112 D Street, Lowell, Mass.

GIVENS, ED. S. (A) manager, owner, Givens Products Co., Box 586, Kansas City, Mo.

GRABLE, EDWARD J. (J) shop foreman, Auto Electric Service Co., 580 Fourth Avenue, Brooklyn, N. Y.; (mail) 464 80th Street.

GROMER, GEORGE N. (M) supervisor, motor vehicles, Mountain States Telephone & Telegraph Co., Denver, Colo.; (mail) 2022 Hudson Street.

HAHN, WILLIAM PERRY (A) member of firm, Hood & Hahn, 1001 Hume-Mansur Building, Indianapolis.

HARRISON, R. L. (A) president, R. L. Harrison Co., Inc., Albuquerque, N. M.; (mail) 123 North Fourth.

HASSEY, JOHN A. (A) automotive superintendent, Cities Service Refining Co., Boston; (mail) 11 Pleasantview Street, Roslindale, Mass.

HILL, EDWARD B. (A) branch manager, Gar Wood Industries, Inc., 3203 Vernon Avenue, Long Island City, N. Y.

HOSSFIELD, HERBERT S. (M) vehicular supervisor, Continental Baking Co., 285 Madison Avenue, New York City; (mail) 276 Van Buren, Teaneck, N. J.

HUTCHESON, JOHN C., CAPT. (S M) motor transportation officer, U. S. Army, Quartermaster Corps, Fort Sill, Okla.

KNUDSEN, WILLIAM J. (M) executive vice-president, General Motors Corp., Detroit; (mail) 1501 Balmoral Drive.

LEIGHTON, JOHN W. (M) president, Pressed Metals of America, Inc., Port Huron, Mich.; (mail) 1712 Military Street.

MELIN, STEN S. (M) engineer, experimental division, Midland Steel Products, Inc., Cleveland; (mail) 448 East 152nd Street.

MEYER, THEODORE F. W. (M) manager, propeller division, Federal-Mogul Corp., Detroit; (mail) 11031 Shoemaker Avenue.

MULLER, RUDOLPH J. (A) consulting automotive engineer, 104-06 Eagle Street, Brisbane, Queensland, Australia.

MILLS, GEORGE W. (A) manager, sales promotion department, Imperial Oil, Ltd., 56 Church Street, Toronto, Ontario, Canada; (mail) 56 Rivercrest Road.

MORSE, HOWARD H. (A) service superintendent, Tracey & Co., Inc., 936 Northwest Couch Street, Portland, Ore.

MOUNT, WILBUR S. (J) automotive engineer, Socony-Vacuum Corp., 412 Greenpoint Avenue, Brooklyn, N. Y.; (mail) 3545 82nd Street, Jackson Heights, L. I., N. Y.

OTWELL, WILLIAM A. (A) owner, Otwell Sales Co., 4829 Woodward Avenue, Detroit.

RAMSAUR, WALTER R. (M) research engineer, Harrison Division, General Motors Corp., Lockport, N. Y.

RUMFORD, GEORGE (M) operating manager, Jefferson plant, Chrysler Motors Corp., 12200 East Jefferson, Detroit; (mail) 17575 Muirland.

SCHWARZ, S. C. (M) chemical engineer, chief chemist, Portland Gas & Coke Co., Public Service Building, Portland, Ore.; (mail) 4235 Northeast Glisan Street.

SMITH, R. BELDON (M) automotive engineer, prestone specialist, National Carbon Co., 30 East 42nd Street, New York; (mail) 408 Summit Avenue, Jersey City, N. J.

TEODORO, ANASTASIO L. (F M) associate professor, head, agricultural engineering department, University of Philippines, Department of Agricultural Engineering, Laguna, P. I.

UTLEY, UHL F. (M) experimental engineer, Dodge Bros. Corp., Detroit; (mail) 17335 Cooley Avenue.

VAN DER SLUYS, WILLIAM, JR. (J) instructor, Stevens Institute of Technology, Castle Point, Hoboken, N. J.; (mail) 185 North Main Street, Paterson, N. J.

VANN, WILLIAM H. (M) chief inspector, Pontiac Motor Co., Pontiac, Mich.; (mail) R.F.D. 2.

VITZ, PAUL (A) superintendent of maintenance, Arrow Carrier Corp., 45 Park Street, Paterson, N. J.; (mail) 130 Lincoln Avenue, Clifton, N. J.

WEBB, KENNETH E. (J) student, Cass Technical High School, Detroit; (mail) 19385 Grandview Avenue.

WHITE, CHARLES O. (A) field representative, Ethyl Gasoline Corp., 612 Subway Terminal Bldg., Los Angeles; (mail) 4835 Buchanan Street.

WHITE, LYSANDER T. (A) power prover department, Cities Service Oil Co., 60 Wall Street, New York City.

WOOLSTEEN, ROBERT BRUCE (J) contractor, partner, Woolsteen & Sons, 928 West Wilcox, Peoria, Ill.

WRIGHT, HENRY THOMAS (J) manager, H. Wright Transport, Lambton Mills, Ontario, Canada; (mail) 110 Government Road.

ZARO, NICHOLAS J. (F M) production manager, General Motors Peninsular, S. A., Barcelona, Spain; (mail) 433 Calle Mallorea.

Applications Received

The applications for membership received between May 15, 1934, and June 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

CHITTICK, M. B., assistant chief chemist, The Pure Oil Co., Chicago.

CURRIN, SYDNEY A., technical representative, Clayton Dewandre Co., Ltd., Lincoln, England.

DONHAM, EDWARD F., supervisor of motor equipment, Illinois Bell Telephone Co., Chicago.

EASTERN MASSACHUSETTS STREET RAILWAY Co., Boston.

EDWARDS, C. J., sales engineer, The Ohio Rubber Co., Detroit.

HANSEN, GEORGE M., mechanic, White Co., Buffalo, N. Y.

HARRIS, W. ERIC, manager, Electric Auto-Lite, Ltd., Sarnia, Ont., Canada.

HERZIG, ALVIN JOHN, chief metallurgist, Climax Molybdenum Co. of Michigan, Detroit.

JOHNN, CECIL CHARLES WILLIAM, engineer, The Shell Co. of Egypt, Ltd., Suez, Egypt.

JOHNSON, LAWRENCE O., owner, L. O. Johnson Repair Service, Portland, Ore.

LAAS, EUGENE, mechanic, Theodore Luce, New York City.

LINDAHL, CARL W., mechanical draftsman, Aluminum Industries, Inc., Cincinnati, Ohio.

MOFFET, J. DONALD, sales manager, Paul G. Hoffman Co., Inc., Los Angeles, Cal.

MUELLER, OTTO, research engineer, Murray Corporation of America, Ecorse, Mich.

MUNOZ, JUSTO ERASMO, engineer, National Technical High School, Buenos Aires, Argentina.

PAUL, W. H., instructor in mechanical engineering, Oregon State College, Corvallis, Ore.

PIRON, EMIL H., engineer, Electric Railways Presidents' Conference Committee, Detroit.

REED, M. J., secretary and treasurer, Diesel Engine Manufacturers Association, New York City.

REID, HOWARD EDWARD, manager, Somerville Paper Boxes, Ltd., Walkerville, Ont., Canada.

REINHARDT, W. L., chief engineer, Willard Storage Battery Co., Cleveland.

SMITH, HARRY DORSETT, New York manager, Aro Equipment Corp., New York City.

VALANCE, EDWARD L., assistant general manager, Houde Engineering Corp., Buffalo, N. Y.

WALTON, ARTHUR LEE, assistant modeler, Solar Aircraft Co., San Diego, Cal.

WHITTED, THOMAS B., JR., 1st Lt., U. S. Army, 5th Field Artillery, Madison Barracks, N. Y.

Summer Meeting Best in Years

(Continued from page 16)

Teague's opinion, airplanes and speedboats are so much more beautiful than automobiles.

Evolving the correct design out of the thing itself, is no easy problem, of course, and Mr. Teague admitted that "the ultimate form of an object may forever elude us, and the finest results may be the last to be achieved before the object itself is obsoleted and superseded by some wholly new form —as the last of the carriages built were the finest."

Lubrication and Winter Oils Argued

Arguments for and against adoption as S.A.E. standards of the 10-W and 20-W oils which have been on trial since last year were heard in the discussion following the paper on "Winter Oils for Automobile Engines," which is printed in full on other pages of this issue. It was brought out, among other things, that the average car owner places extremely strong emphasis on oil consumption and that it is not easy to convince him of the favorable characteristics of lighter oils in the face of increased consumption. Ralph Teetor, Perfect Circle Co., declared himself favorable to oils as light as possible, mentioning tests made in his laboratories in which no more difficulty was experienced in sealing rings with the lighter than with the heavier oils and in which no difference in wear was noticeable. But, he expressed the opinion that the temperature of the oil under operating conditions is most important—and would become more important with use of these lighter oils and that this temperature is due to engine operating temperature. Maximum operating temperature should be reduced, he said, by some method of cooling when using the lighter oils in high duty service.

A goodly crowd of more than 200 listened to two excellent papers dealing with various types of bearing, notably, the copper-lead alloys and their lubrication, on Wednesday evening. In the first paper Stanwood W. Sparrow of Studebaker outlined tests of babbitt and copper-lead alloys. He said in part: "The initial cause of failure (in babbitt bearings) is often the cracking of the babbitt. . . . The primary cause of failure has been the reduction in the amount and viscosity of the oil applied." He showed sets of copper-lead bearings in good condition after 50-hr. tests at 4500 r.p.m., whereas in other tests failure of babbitt had made it necessary to discontinue the test after 30 hr. It appeared, however, that many other factors besides the bearing alloy used had important effects upon the results secured.

C. M. Larson's paper treated the subject more in reference to the lubricant employed, including its effect upon the alloy used. According to Mr. Larson, a summation of the data obtained in his tests, "shows that certain metals cause some mineral oils to deteriorate more readily than others and that high acidity in motor oils causes not only more rapid decomposition of the lubricants themselves, but of the bearing metal as well. . . . Copper-lead bearings . . . are coming into use fast because actual service has indicated longer bearing life."

Discussion led to the suggestion that certain phases of the subject treated need further study and that there should be a committee appointed with representatives from the automotive and petroleum industries to consider and report on the matter later. It was made clear in the discussion, especially by F. F. Kishline and A. L. Clayden, that high temperatures are destructive of both oil and bearings. Mr. Sparrow agreed and said that much can be done to reduce temperatures, especially of main bearings.

As expected, the two very timely papers presented at Thursday morning's engine session made the latter one of the outstanding features of the meeting, especially from the standpoint of the passenger car engineer. L. P. Kalb's paper was commended as presenting an excellent long-range view of future engines adapted to modern automobile design trends, especially as to types suited for location in the rear of the chassis, which many engineers seem to think is the coming arrangement. "With radical changes in car structure in the offing," said Mr. Kalb, "it is probable that changes in engine arrangement are also imminent. . . . Mounting of the engine in the rear of the car has many advantages. With the conventional line engine, however, it is doubtful if the advantages of rear location would offset its disadvantages."

Louis Schwitzer's paper on the possibilities of forced induc-

The airplane shock-absorber session on Friday had a small but enthusiastic audience and discussion lasted for several hours

tion gave an intimate picture of the advantages of supercharging and showed how these advantages have been realized in various applications. He expressed the conviction that, "in a comparatively short time, automatic or atmospheric induction will have gone the way of automatic intake valves, and mechanical induction will become the general thing." Much of the discussion centered around streamlining, with which Mr. Schwitzer dealt at some length. Discussers included F. F. Kishline, F. C. Mock, Lowell H. Brown, Austin M. Wolf, Joseph A. Anglada and G. L. McCain, most of whom were in sympathy with points made by the author. A written discussion from Sanford A. Moss criticized the low efficiency attained with the Schwitzer-Cummins supercharger, but the author was inclined to discount both the possibilities and the need for higher efficiencies, and also stated that there is no need for higher pressures than are developed (about 3½ to 4 lb. per sq. in.) in applications to automobile engines.

Airplane Propeller Symposium

At the propeller symposium, the authors of the five papers and the chairman of the session carried the burden of a discussion which was none the less active and candid.

As Chairman Edward P. Warner observed in his general introduction, four of the five papers on the program covered individually all of the controllable-pitch propellers that are now upon the market or in a very advanced stage of development, while the fifth dealt with a problem common to all designs. Frank W. Caldwell, recently winner of the Collier Trophy for the outstanding technical development of the year in American aviation, spoke for Hamilton Standard and incidentally surveyed the present state of propeller theory and design practice, with special reference to the study of vibratory stresses and failures by flutter, before going on to his own particular experiences with the controllable-pitch type. G. T. Lampton spoke for the steel-bladed Smith-Lycoming, T. P. Wright for the electrically-operated Curtiss-Wright, and C. H. Havill for the automatically-variable-pitch Eclipse. Thomas Barish of Marlin-Rockwell treated the vexed theme of blade-root bearings for variable-pitch types, a problem to the extraordinary difficulty of which several of the other speakers had paid tribute.

Mr. Caldwell, after showing many curves of stress variation along a blade under various modes of vibration and explaining the method of calculating vibration frequency by equating potential strain energy in the blade at its position of maximum deflection in the vibratory cycle to kinetic energy in the neutral position where the blade elements possess their largest linear velocities due to vibration, turned to the effect of variable propeller pitch on the performance characteristics of a plane. Mr. Wright, too, dealt with that topic. The collective conclusion was that variable pitch does most good on take-off, on high-altitude cruising, and on ceiling, especially with one or more engines dead. Take-off distance is typically

(Left to Right) **Carlton Kemper, speaker, Cooling and Detonation Session; G. T. Lampton, speaker, Propeller Symposium; Torbjorn Dillstrom, speaker, Diesel Design Session**

reduced about 25 per cent, while ceiling is increased (either with full power or with one engine gone) about 3000 to 4000 ft.

The paper by Mr. Havill analyzed in detail the forces, both aerodynamic and centrifugal, acting on a propeller and conceivably available for producing automatic pitch changes to correspond to varying conditions of flight. He had concluded that the thrust was the best force to use for the purpose, the propeller mechanism being so designed that the blade angles would automatically increase as the thrust diminished, and vice versa. Centrifugal forces were too large to be convenient (Mr. Barish gave figures showing that in some instances they exceed 200,000 lb. on a blade), and torque forces were either too small to be reliable or required the intervention of a manually-applied correction for throttle setting.

The discussion of the group of papers led immediately to a vigorous defense of the hollow steel propeller blade against the somewhat critical observations of Mr. Caldwell, upholder of the light-alloy type. Hamilton Foley of the Pittsburgh Screw & Bolt Co., makers of the steel blades used in the Smith-Lycoming propellers, protested against lumping all blades of that material within the scope of any set of generalizations and expressed his own conviction that steel blades properly made and properly tested by modern methods could and did compare favorably in reliability, freedom from incidental damage, and weight with blades of any other material whatever. Mr. Caldwell, replying, repudiated any desire on his own part to be categorical. He had an open mind on the matter, but he had recorded in his paper his own conclusions from his own experience and observations up to that time.

Other discussion bore on friction, with a general agreement that up to the point where it began to produce excessive wear or immediate permanent deformation bearing friction was a good thing and should be as large as possible. Mr. Lampton was particularly emphatic on that point. The effect of engine test specifications on the value of pitch variation was taken up, and it was agreed that British rules for engine operation provided much less incentive for the employment of controllable-pitch types than did their American equivalents, but

(Continued on page 34B)

(Left to Right) **Lowell Thomas, speaker at General Session, Thursday; L. R. Buckendale, Chairman, Diesel Fuels Session; O. C. Bridgeman, speaker, Passenger Car Fuels and Lubricants Session; E. S. Taylor, speaker, Design and Combustion Studies; J. W. Votypka, chairman, Body Design Session**

The Field Day and Golf Events Furnished Variety and Thrills

S.A.E. Summer Meeting, Saranac Inn, N.Y., June 17-22, 1934

GOLF

Kickers Handicap—Men

Sunday	A. A. Warner D. D. Robertson Fred Hall C. J. Edwards Jos. Halbleib	Net 84
Monday	F. Marshall } 1st Sandy Brown } W. K. Lee R. H. Combs F. W. Parker H. K. Intermann	Net 72
Tuesday	J. P. Stewart 1st	Net 77
	R. H. Wulf } 2nd C. F. Lautz }	Net 74
Wednesday	Howard Dingle Burns Dick C. E. Dwyer Chas. Guernsey W. H. Hubner Fred Hall, Jr.	Net 78
Thursday	W. H. Oldacre	Net 71
	G. W. Waters } Howard Dingle }	Net 76

Kickers Handicap—Ladies

Monday—	1st Prize	Mrs. C. M. Larson
Wednesday—1st	"	Mrs. D. E. Gamble
Thursday—	1st "	Mrs. H. E. Figgie

S.A.E. SPORTS EVENTS

WATER CARNIVAL

Men —1st Prize	Fred Hall	
2nd "	A. A. Lane	
Ladies—1st "	Miss Betty Rockwell	
2nd "	Mrs. H. E. Figgie	

FIELD DAY SPORTS

Men —1st Prize	J. M. Simpson
2nd "	W. E. England
Ladies—1st "	Miss Charlotte Anglada
2nd "	Mrs. R. E. Wilkin

LADIES BRIDGE

Monday—
Contract 1st Prize Mrs. H. W. Farr

Tuesday—
Contract 1st " Mrs. C. F. Lautz
2nd " Mrs. H. W. Farr

Wednesday—
Contract 1st " Mrs. W. T. Murden

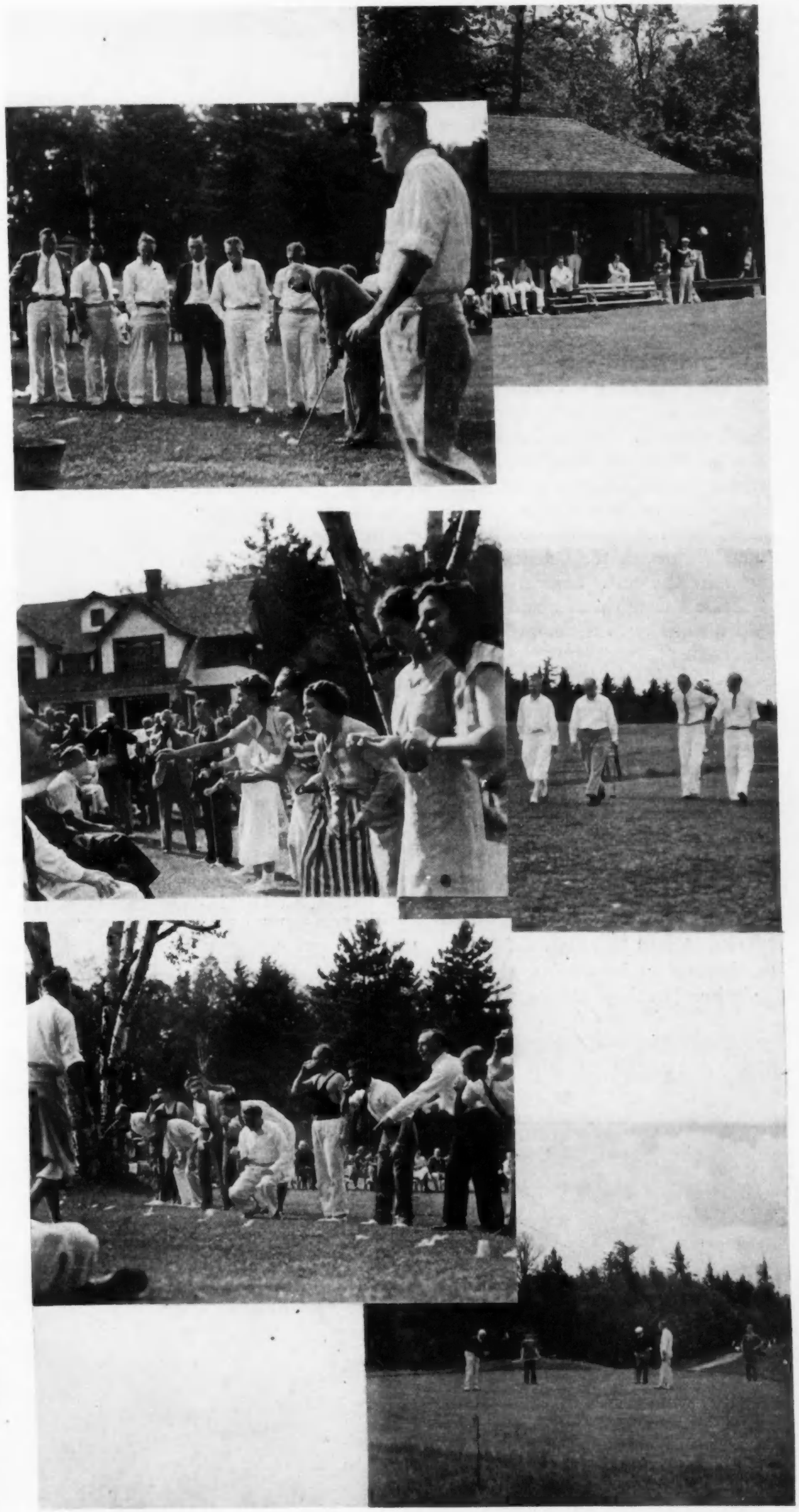
GOLF TOURNAMENT

Ladies' Championship

1st	Mrs. J. C. Tuttle	Tied 107-113-220
1st	Mrs. Wm. J. Cumming	112-108-220

Men's Championship

	1st	C. W. McKinley	87-83-170
	2nd	C. J. Edwards	84-87-171
Flight A	1st	J. F. Cast	71-73-144
	2nd	R. F. Steeneck	74-74-148
Flight B	1st	W. G. Clark	73-70-143
	2nd	O. B. Lewis	69-75-144
Flight C	1st	J. S. Drake	71-73-144
	2nd	W. H. Oldacre	70-76-146



no one could understand why British designers seemed so indifferent to the apparently immense value of controllable-pitch variation on their military planes with very highly supercharged engines.

There was some scepticism over the possibility of securing a completely automatic propeller that would meet all possible flight conditions with satisfactory efficiency. Mr. Wright was inclined to favor a governor type of control, with the pitch automatically varying to hold a rate of engine rotation for which the pilot might set his index. Mr. Havill refused to concede that a propeller like that would be a truly automatic one at all, but all parties finally appeared to accept it that there would probably be no unique solution and that it might well be desirable to use one type of pitch control on a transport airplane, another type on a fighter, and perhaps still a third type on a ship destined for the private-owner-pilot.

Aircraft Engines and Fuels

One of the many contributions which members of the staff of the Bureau of Standards have made in S.A.E. meetings was the paper entitled "Observation of Flame in an Engine," by Charles F. Malvin, Jr. It dealt with a visual and photographic study of combustion through a cylinder head with windows and using a stroboscope to time the observations. According to the author, "about 36 deg. or six thousandths of a second at 1000 r.p.m. was required to complete inflamation." A device for determining spectral radiation was also used in the test. Several pages of text were required to describe the apparatus and the results secured. The latter add materially to the knowledge of the complex phenomena observed.

E. S. Taylor presented the second paper which outlined the design limitations of aircraft engines by the use of the principle of similarity. Among other conclusions the author stated that "Large engines run under much more severe conditions (than small ones). . . . Because of cooling limitations . . . the necessity of using lower compression ratios in larger engines, the overall efficiency of the small engine will be higher, if a proper lubricant is used."

Discussion dealt largely with minor points, but both authors were commended and it was the view of Dr. H. C. Dickinson, among other discussers, that the tests reported by Mr. Marvin should be continued to secure further data intended to clear up various points that need elucidation.

Arthur Nutt's paper on "Correlation of Knock Rating of Aviation Gasoline" was really a progress report of a subcommittee appointed to study knock ratings of fuels and to correlate test results obtained on C.F.R. engines with those obtained on full-size engines. As the test is only half completed, the author stated that final conclusions could not be given. He reported that "straight-run fuels in the full scale engine show little if any deviation, from the C.F.R. motor-method octane number. Benzol blends show a depreciation, particularly in the higher octane numbers on the larger engines. On the larger air-cooled engines, the cracked gasolines show a limited depreciation in the lower octane numbers . . ."

Talking on the design and baffling of finned air-cooled cylinders, Carlton Kemper of the N.A.C.A. gave a record of a series of basic tests on cylinders with and without baffles and with certain other factors varied. Data presented showed that some forms of baffles, especially those that were welded to the cylinder fins result in a material increase in the heat dissipated.

Discussion of both papers consisted largely of questions in which certain points were elucidated. There was some disposition to question certain of the results secured in the tests reported by Mr. Nutt, but he stressed the point that the tests are only half completed as yet and must be regarded definitely as tests of fuels and not of engines, the latter being used merely to make the required determinations.

Study may show how some of the elaborate tests applied to determine riding comfort in automobiles may also be used in connection with the airplane landing-gear. This possible eventuality was visualized by C. V. Johnson, of Bendix Products, who wound up the list of speakers with some pertinent remarks about airplane shock-absorbers.

The airplane landing-gear has been under indictment for a couple of years, Mr. Johnson intimated, first because it has contributed as much as 20 per cent of the drag of the plane in flight, and, second, because it is alleged that 70 per cent of the structural failures of the plane causing accidents are in the landing gear.

The first condition is being corrected by wider use of retractible landing gear, and the second is not so serious as it seems at first mention, because in the event of a plane landing hard enough to cause a structural failure, such failure should be in the landing gear, according to Mr. Johnson. An adequate shock-absorbing system is the greatest factor in eliminating landing-gear failures, he said.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members. Orders should specify the name of the author as well as the title of the paper desired.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Abbott, Dr. E. J.
The Place of Sound Measurements in Automobile Noise Reduction

Barish, Thomas
Bearings for Controllable Propellers

Barnard, D. P.
Butane Vs. Gasoline As an Automotive Fuel

Bleicher, C. E.
External Broaching

Bleicher, C. E.
Relative Merits of Precision Manufacturing and Correct Plant Layout to Accomplish Cost, Quality and Uniformity of Parts Production

Brettell, Clinton
How Economies in Motor Vehicle Operation Can Be Effected from an Operator's Standpoint

Briggs, Commander W., and Fox, M. L.
Body Noise

Broulhiet, Georges
Quality Objectives for Engineers—An official communication from the Societe des Ingenieurs de l'Automobile de France

Brown, Lowell H., and Herbert Chase
Streamlining—Up-to-date Facts and Developments

Brown, W. C., and Roper, V. J.
The Well-Lighted Car

Bull, A. W.
Tire Noise

Caldwell, F. W.
Recent Developments in Aircraft Propellers

Cass, Robert
Future Trends in Motor Truck Transportation

Chandler, F. F.
Notes on Steering

DeSmet, E. C.
Planography—The New Science of Surface Design

Dillstrom, Torbjorn
A High-Power Spark Ignition Injection Engine

Drake, H. W.
Problems of the Fleet Operator

Faulkner, F. L.
Vehicle Design from a Maintenance and Operating Standpoint

Fischer, Hans
Typical Indicator Diagram Analysis with Respect to Effective Combustion

Fisher, J. B.
Combustion Problems on Automotive Diesel Engines

Fitzsimmons, J. T.
Problems and Tendencies in Electrical Equipment

Fodor, Nicholas
Hydraulics of High-Speed Fuel Injection

Froesch, Charles
Some Aspects of Commercial Aviation

Frye, Jack
New Airline Advancements: Maintenance and Operations

Geschelin, J.
Trends and Future Developments in Motor Truck Design

Guernsey, C. O.
Trends in the Design and Application of Motor Trains

Haarz, W. G., Jr.
Beauty Sells Cars in 1934

Hazard, S., Jr.
Sound Absorption and Deadening

Horner, F. C.
Looking Forward in the Field of Transportation

Howard, H. H.
Some Diesel Tractor Problems

Hunsaker, J. C.
Airships for Commercial Purposes

Jacoby, E. R.
Practical Design Consideration of the Internal Combustion Engine Structure

Johnson, C. V.
The Airplane Landing-Gear Shock-Absorbing System

Johnson, W. M.
A Résumé—and Some Conclusions about Automotive Electrical Equipment

Kalb, L. P.
Engine Types Adapted to Automobile Design Trends

Kuttner, Julius, and Rippere, J. B.
Ignition Delay of Diesel Fuels Measured by Bouncing Pin in C.F.R. Engine

Lampton, G. T.
The Design Requirements of a Mechanical Controllable Propeller

Lansing, R. P.
Starters for Diesel Engines

Larson, C. M.
Lubrication of Engines with Different Bearing Metals, with Special Reference to Copper Lead Alloys

McCormick, Fowler
The Relation of Engineering to Manufacturing and Distribution in the Farm Implement Industry

Macauley, J. B.
Fuel Economy from the Engine Designer's Point of View

Mock, F. C.
Utilization of Heavy Fuel With Spark Ignition

Moss, F. A.
Air Conditioning and Relative Refinements for Auto Bodies

Norris, R. F.
The Automobile Motor Considered as a Sound Source

Northup, A. E.
Future Streamlining

Nutt, Arthur
Detonation Rating of Aviation Fuels

Orr, J. M.
Accident Control in Fleet Operation

Orr, J. M.
Predetermined Operating Requirements for Purchasing Equipment

Peterson, C. D.
Multi-Range Transmissions

Prescott, F. L.
High-Output Poppet-Valve Cylinders

(Continued on next page)

Papers Available in Mimeographed Form

(Continued from preceding page)

Robertson, D. D.
Hydraulic Action in Piston Ring Design

Schwitzer, Louis
The Possibilities of Forced Induction in Automotive Vehicles

Shepard, E. H.
The Economy Fallacy

Slonneger, J. C.
Effective Combustion as Determined from the Indicator Diagram

Smith, C. W.
Comparative Tests of Pneumatic Tires and Steel Wheels on Farm Tractors in Agricultural Operations

Smith, G. W., Jr.
A Technical Education

Staley, A. C.
Requirements of Tractor and Diesel Engines

Stewart, J. P., and Risk, T. H.
Factors Affecting Oil Consumption

Taylor, E. S.
Design Limitations of Aircraft Engines

Teetor, R. R.
Conformity of Cylinders, Pistons and Rings

Thee, W. C.
Standardization of Military Motor Equipment

Tirrell, E. L.
Weight Distribution on Front and Rear Axles of Motor Truck

Treiber, O. D.
Factors in Automotive Diesel Development

Veal, C. B.
Mind or Micrometer

Wheeler, P. R.
Human Engineering

White, L. T.
Why Waste Fuel Through the Exhaust?

Wolf, A. M.
Lightness in Truck Design

Wright, T. P.
Controllable Pitch Propellers—Design Considerations

Zucrow, M. J.
Some Experiences with Heavy Fuel Equipment for Spark Ignition Engines

Regional Meetings Program Develops Rapidly

CONTACT of the Society with its individual members through meetings promises to be considerably broadened by a plan for Regional Meetings, which was authorized by Council action last March. These meetings are intended to be held in cities where there are groups of S.A.E. members who do not have ready access to regular section and national meetings.

Two successful meetings have already been held, with the consent and cooperation of the Sections in whose territory the session was scheduled. On May 18 the Oregon Section held a meeting at Salem, Ore., which was attended by members from Portland, besides giving faculty and students of the Oregon State College an opportunity to become closer acquainted with the methods and personnel of the Society.

On May 22, a regional meeting under the aegis of the Chicago Section was held in South Bend, Ind., to hear a paper on "The Development of a Modern High-Speed Automobile Engine," by S. W. Sparrow. This meeting was attended by between 145 and 150 members of the S.A.E. and the American Society of Mechanical Engineers, who were invited to attend the meeting.

Discussion of Mr. Sparrow's paper was led by D. G. Roos, president of the Society, and was participated in by, among others, Harold Nutt, chairman of the Chicago Section; Ralph Teetor, R. E. Wilkin, H. F. Bryan and Scott Hunt.

At the South Bend meeting there was displayed a representative group of engine parts, some of which had been removed from engines after endurance runs. More than 50 slides were used in illustrating Mr. Sparrow's paper. Several suggestions were heard after the meetings indicating that the opinion of such meetings called for "more."

How successful regional meetings may be from the standpoint of attendance was illustrated by an outing sponsored by the Cleveland Section and held at the plant of the Timken Roller Bearing Co., Canton, Ohio. The outing was attended by more than 250 members of the Society, who came from the Detroit area and most of the industrial towns of Ohio.

Inquiry has been directed to every Section relative to the feasibility of holding regional meetings in that Section's territory, at some point away from the usual meeting city, so that members of the Society outside convenient traveling distance from that city might be interested in attending.

Replies favoring the possibility have been received from a majority of the Sections concerned. Northern California reported that it has already had success with the plan of alternating the Northern California Section meeting between the cities of San Francisco and Oakland.

The Syracuse Section reported that a meeting held in Elmira, N. Y., drew a large attendance, and it believed a successful meeting could be held in Williamsport, Pa.

The Kansas City, St. Louis, and Wichita Sections have discussed the possibility of a regional meeting which would include all three.

Milwaukee notes that there are several cities within the Section's territory in which such meetings might be held and looks on the idea with favorable eyes. Some of the cities mentioned were Waukesha, Beloit, Madison, Racine, Kenosha, Green Bay, Oshkosh and Clintonville.

The Detroit Section mentions the possibility of arousing interest in such meetings in cities such as Pontiac, Flint, Lansing and Toledo.

In Canada, the Canadian Section mentions Montreal as offering a good possibility, because there are quite a few members of the Society in the immediate neighborhood.

The Regional Meeting plan was suggested to the Council by Alex Taub, chairman of the general meetings committee.

Experience to date with the idea indicates that its success depends chiefly on there being available cities in a Section's territory which furnish a good focal point, and where a number of members are resident.

One or two sections report that had they had more time in which to build up adequate publicity for the meeting, the attendance would have been larger, but a general tone of satisfaction with the idea is evident.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Experimental Verification of the Theory of Wind-Tunnel Boundary Interference

By Theodore Theodorsen and Abe Silverstein. N.A.C.A. Report No 478, 1934; 17 pp., with tables and charts. Price, 10 cents. [A-1]

The Aerodynamic Effects of Wing Cut-Outs

By Albert Sherman. N.A.C.A. Report No. 480, 1934; 8 pp. with 3 figs. Price, 5 cents. [A-1]

Wind-Tunnel Measurements of Air Loads on Split Flaps

By Carl J. Wenzinger. N.A.C.A. Technical Note No. 498, May, 1934; 8 pp., 11 figs. [A-1]

Torsional Stresses in Box Beams with Cross Sections Partially Restrained Against Warping

By Hans Ebner. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, Nos. 23 & 24, December 14, and 28, 1933; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 744, May, 1934; 49 pp., 24 figs. [A-1]

High-Speed Aircraft

By M. Schrenk. Translated from *Zeitschrift des Vereines deutscher Ingenieure,* Vol. 78, No. 2, January 13, 1934. N.A.C.A. Technical Memorandum No. 745, May, 1934; 12 pp., 23 figs. [A-1]

The High-Speed Heinkel HE 70 Mail Airplane

By Ernst Heinkel. Translated from *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 24, No. 24, December 28, 1933. N.A.C.A. Technical Memorandum No. 746, May, 1934; 15 pp., 11 figs. [A-1]

Motion of Flying Boats During Take-Off and Landing Run

By Taitiro Ogawa and Yosiro Murata. Report No. 105 of the Aeronautical Research Institute, Tokio Imperial University, April, 1934; 44 pp., with tables and charts. [A-1]

Technical Aerodynamics

By K. D. Wood. Published in mimeograph form by the College of Engineering, Cornell University, Ithaca, New York, 1933; about 250 pp. [A-1]

This textbook, intended for use in an undergraduate course in Aerodynamics at Cornell University, aims to contribute to the training of students who wish to prepare for technical engineering work in the design and manufacture of aircraft, with the emphasis on the fundamental principles of mechanics and hydrodynamics rather than on technical details of construction and operation.

Histoire, Technique et Variantes de l'Avion-Automobile

By René Tampier. Published in *L'Aéronautique,* May, 1934, p. 110. [A-1]

An aircraft-automobile is defined as a vehicle in which one may drive from his garage in the city, unfold its wings on arrival at a suitable place and fly. The history, technical details of design and construction and various forms of such a vehicle are discussed in this article.

(Continued on page 38)


EXCHANGE 7-
2376

NOTES AND REVIEWS

Continued

Recherches Poursuivies au Laboratoire de Physique du Service des Recherches de l'Aéronautique, ou en Collaboration avec Lui

Published in *L'Aéronautique,* March, 1934, L'Aerotechnique section, p. 25. [A-1]

A series of brief reports here summarizes the research being carried out by the physical laboratory of the aeronautic research service, or in collaboration with it. Some of the subjects are: the thermal conductivity of metals; air cooling of metals; the specific heat of oils at high temperatures; heating caused by high speed displacement in air; aviation apparel; high tension magnetos and spark plugs.

Examen de l'Aviation Privée

By Henri Boughé. Published in *L'Aéronautique,* May, 1934, p. 90. [A-4]

Increasing private usage of the airplane awaits the development not of a cheaper vehicle, but of an aircraft and aviation facilities that will give the private owner security, satisfaction and pleasure. This opinion is expressed in the present summary of private airplane usage. Other articles in the same issue on this general topic deal with the piloting of touring aircraft, the history of private ownership of airplanes and private airdromes.

Le Sauvetage Collectif dans l'Aviation de Transport

Published in *L'Aéronautique,* March, 1934, p. 55. [A-4]

After three years of research on the problem of collective rescue for the passengers and pilots of a disabled airplane, a device said to be practicable has been developed. It consists of building the cabin of the airplane structurally separate from the airplane as a whole, providing for the launching of the cabin from the airplane in flight, and of a large parachute as a sustaining means.

Positions de Vol et Figures de Virtuosité Aérienne

By Gerhard Fieseler. Published in *L'Aéronautique,* April, 1934, p. 71. [A-4]

Certain flight positions, such as the tail spin, inverted flight, diving and side slip are defined. The author then discusses the formation of figures during flight, both the fundamental type and combinations of them less frequently executed.

Contributions à l'Etude et à l'Essai des Parachutes

By R. Alkan. Published in *L'Aéronautique,* April 1934, L'Aérotechnique section, p. 37. [A-4]

The research on parachutes here reported is divided into two sections, one dealing with the fabric used and the other with the necessity of eliminating the personal factor in testing the launching of the parachute.

BODY

Supplement to Motor Body Designing Problems

By George J. Mercer. Published by Ware Brothers Co., Philadelphia, 1933; 48 pp. [B-1]

The author explains that in his previous work, "Motor Body Designing Problems," no effort was made to include elementary geometrical procedure since it was intended to serve as a concise, ready reference on body engineering practice for those with experience. To make this previous work of greater use than originally intended, the "Supplement" has been issued. The first part deals with elementary geometrical problems to indicate the line of study which the student should pursue, then follow elementary geometrical functions which form the basis of the problems contained in the book.

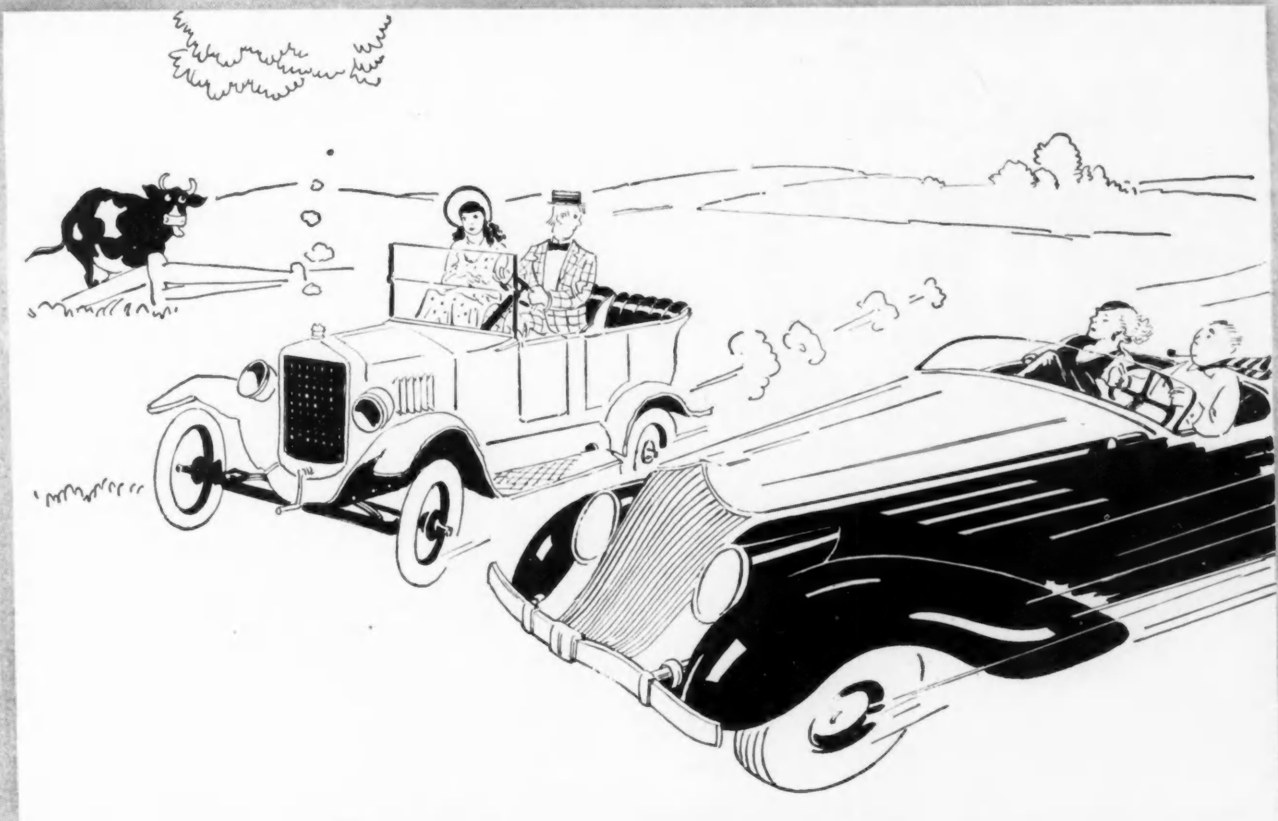
CHASSIS PARTS

Car Design Trends Call for New Deal in Chassis Construction

By F. B. von Barenyi. Published in *Automotive Industries,* April 28, 1934, p. 518. [C-1]

The author stresses the advantages of the tubular backbone over the panel-type chassis frame, particularly in connection with the widespread adoption of independent springing, which, he points out, admittedly calls for chassis structures of greater torsional rigidity.

(Continued on page 40)



NOTES AND REVIEWS

Continued

Theory and Design of Laminated Springs

By H. S. Rowell. Published in *The I. A. E. Journal,* April, 1934, p. 41. [C-1]

The author discusses the underlying principles of spring design and shows by the results of experimental work the fallacies of some widely accepted theories and practices.

La Dispersion et la Selection de la Lumière Appliquées aux Projecteurs d'Automobile

By Alfred Monnier and Marcel Mouton. Published in *Journal de la Société des Ingénieurs de l'Automobile,* March, 1934, p. 2630. [C-1]

The two authors, engineers of the Yvel lamp company, set forth the considerations leading to the development of their lighting system the essential feature of which is a diffusing lamp of the corrugated type made of glass having the property of absorbing violet, indigo and blue radiations and transmitting the green, yellow, orange and red radiations with the minimum of absorption.

ENGINES

The Engine Indicator—Its Design, Theory and Special Applications

By Kalman J. DeJuhasz. Published by Instruments Publishing Co., New York, 1934; 243 pp., illustrated. [E-1]

To present the history, theory and construction of the many forms of the pressure indicator from its inception to the present day, is the purpose of this book as set forth by the author.

Professor DeJuhasz in his professional work in educational institutions, engineering instrument companies and automotive companies and in connection with the development of his own high-speed engine indicator has had wide experience in this field. His notes collected through years of study and research form the nucleus of this book.

La Technique du Graissage et les Moteurs d'Automobiles

By H. Brillié. Published in *Journal de la Société des Ingénieurs de l'Automobile,* March, 1934, p. 2642. [E-1]

A resumé is given of the theory of oil-film lubrication leading up to a description of a device for use in journal bearings said to assure the formation of the oil film, its stability and its high efficiency. The technical aspects of the operation of the device are explained and results obtained with it reported.

The Lubrication of Bearings Provided with Oil Circuits

By M. H. Brillie. Published in *Engineering,* April 13, 1934, p. 441. [E-4]

The author refers to a previous paper presented in 1929 in collaboration with Dr. A. M. Robb, on the theory of the oil film in the lubrication of bearings. Since that time the investigations have been continued, particularly those concerning the different conditions in which the "partial film" may present itself, and general formulae applicable to that case have been developed.

The present article gives an abstact of the conclusions of these researches, together with the practical formulae deduced therefrom, and attention is called to a new device and preliminary results obtained with it in the laboratory.

MATERIAL

Spontaneous Ignition Temperature of Liquid Hydrocarbons at Atmospheric Pressure

By F. J. Dykstra and Graham Edgar. Published in *Industrial and Engineering Chemistry,* May, 1934, p. 509. [G-1]

Vapor-phase ignition temperatures of a sample of gasoline and of n-octane and 2,2,4-trimethylpentane were measured in a glass apparatus under a variety of conditions.

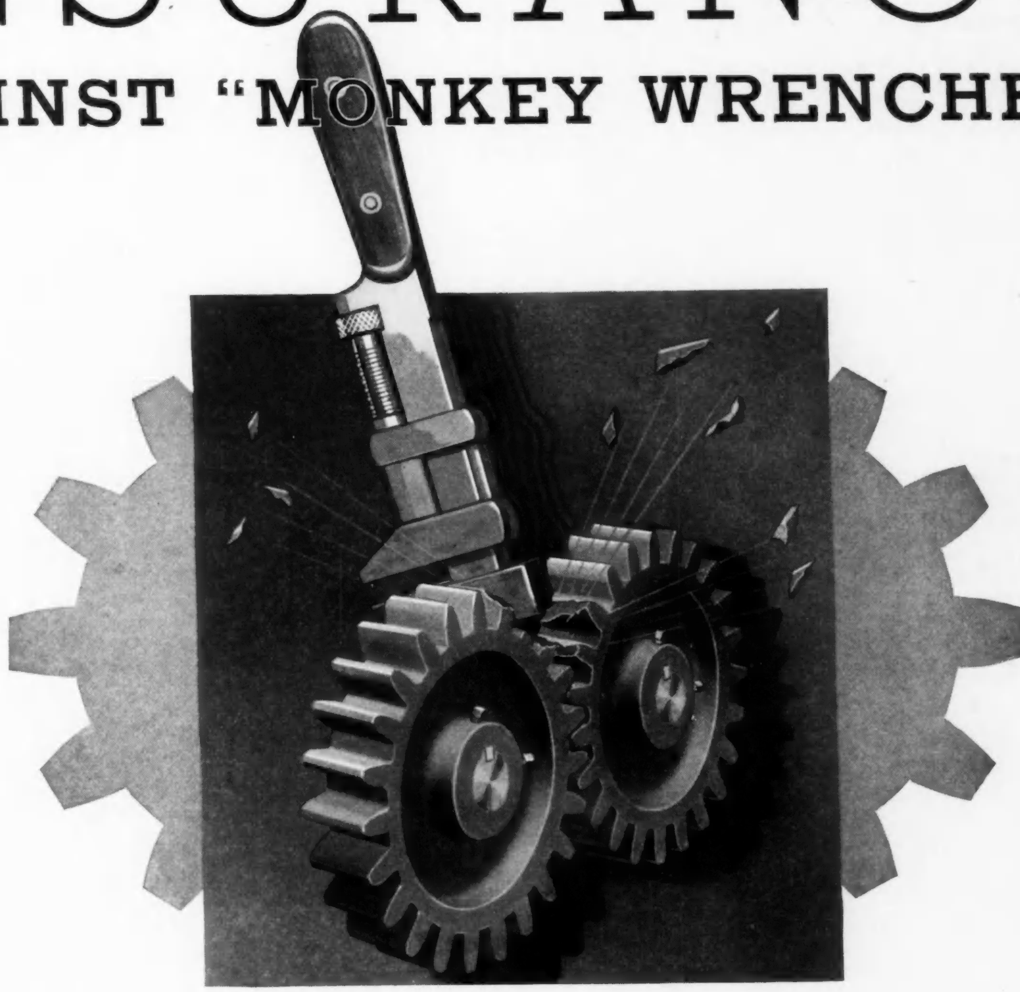
The authors explain that for some given fuel-oxygen-nitrogen mixtures, two types of ignition temperatures can be obtained for the same fuel: a low-temperature ignition, practically independent of fuel concentration or oxygen-fuel ratio: and a high-temperature ignition, temperature varying markedly with variations in these variables. These two ignition temperatures are separated by a zone of nonignition.

In conclusion it is pointed out that ignition of a hydrocarbon fuel is a complicated phenomenon, and care should be employed in interpreting experimental data.

(Continued on page 42)

INSURANCE

AGAINST "MONKEY WRENCHES"



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NOTES AND REVIEWS

Continued

The Corrosion and Protection of Magnesium and Its Light Alloys

By Guy D. Bengough and L. Whitby. Published in *The Journal of The Royal Aeronautical Society,* May, 1934, p. 413. [G-1]

Since a principal use of magnesium alloys is for aircraft and motor parts which are exposed to the atmosphere, either in the presence or absence of liquid fuels and lubricating oils, the work of these authors has dealt mainly with the corrosion effects of the atmosphere, usually reinforced with sea-water spray.

The work which forms the basis for this paper was carried out for the Corrosion of Metals Research Committee of the Department of Scientific and Industrial Research.

Light Alloys for Aeronautical Purposes with Special Reference to Magnesium

By Leslie Aitchison. Published in *The Journal of the Royal Aeronautical Society,* May, 1934, p. 382. [G-1]

Alloys rich in magnesium and those aluminum alloys which possess definitely useful properties in consequence of the presence in them of certain relatively small proportions of magnesium, are considered and data of a fundamental type are provided as a service to the aeronautical engineer for use in comparing the relative importance and value of the magnesium alloys made available to him commercially.

Ethyl—Some Information on the Use and Advantages Gained by the Employment of Tetraethyl Lead in Fuels for Aviation Engines

By F. R. Banks. Published in *The Journal of the Royal Aeronautical Society,* April, 1934, p. 309. [G-1]

The author explains that his paper is an effort to present as complete information as possible on the subject of a much discussed anti-knock material and to endeavor to dispel any misconceptions which some may have regarding the use and behavior of tetraethyl lead. The paper is comprehensive and includes reference to the work of the Cooperative Fuel Research Committee and its subcommittees.

Nouvelles Recherches sur l'Utilisation des Combustibles dans les Moteurs Diesel

By Fr. Sass. Published in *La Revue des Combus-Liquides,* Jan.-Feb., 1934, p. 1. [G-1]

The lack of standardization of Diesel fuels or even of agreement on the desirable qualities of such fuels is attributed to the variety of fuels and engines in use. Specifications for Diesel fuels and their defects are discussed, and a review is given of the theory of Diesel fuel combustion and of research on ignition lag.

Richtige Werkstoffwahl im Maschinenbau

By Max Schmidt. Published in *Sparwirtschaft,* March, p. 65; April, 1934, p. 103. [G-1]

To provide a guide to assist the engineer in making a correct selection among the large variety of alloy steels, the author compares these as to price, properties, the effect of heat treatment and of the different alloying elements. He then cites a few special cases of steels used where high temperature affects the stresses involved.

Die Verwendung von Aluminium im Kraftfahrzeugbau

By Roland Sterner-Rainer. Published in *Automobiltechnische Zeitschrift,* April 25, 1934. [G-1]

Predicting that the efforts at weight reduction now being put forth will significantly increase the usage of aluminum in automotive construction, the author gives the composition, heat treatment and field of application of some commercial aluminum alloys and draws up an imposing list of automotive parts for which aluminum alloys may be used.

MISCELLANEOUS

Les Nouveautés Industrielles en 1934

Published in *La Technique Moderne,* May 1, 1934. [H-4]

Outstanding industrial developments during the first quarter of 1934 are briefly indicated in this introductory article and covered more fully in subsequent treatises in this issue dealing with metals, production equipment, hand and machine tools, foundry practice, internal-combustion engines, electro-technique, welding, pumps and compressors and metal protection.

(*Continued on page 46*)

NOTES AND REVIEWS

Continued

MOTORCOACH

The Design of Public-Service Bodywork

By A. J. Romer. Published in *The I. A. E. Journal*, May, 1934, p. 10. [J-1]

Believing that motorcoaches have now been in general use for a sufficient number of years to allow the design to become stabilized to some extent, and for definite practices to become established, a committee was set up by a group of operators in Great Britain to investigate this matter. A questionnaire was circulated to some twelve important companies, touching on the leading features of design, and the replies revealed complete disagreement in regard to such matters as the best position for the entrance door, the type of entrance door, the class of vehicles which should be fitted with opening roofs, the number and type of drop windows required, the design of the cab, the materials from which the main body panelling should be constructed, methods of ventilation, the amount and location of luggage accommodation required, the type of indicator fittings and the necessity for interior heating.

PASSENGER CAR

Le Salon de l'Automobile de Berlin (8-18 Mars 1934)

By G. Delanghe. Published in *Le Génie Civil*, May 5, 1934, p. 393. [L-1]

The increase in the number of exhibits from 309 to 510 is concrete evidence of the economic importance of the 1934 German automobile show, which, in the opinion of the author, was a solemn manifestation of the rebirth of the German automotive industry under governmental patronage. No less significant were important and novel technical developments here described.

Welche Ansprüche Müssten an einen von der Industrie Gemeinsam Erzeugten Volkstyp Gestellt Werden Konnen?

By Heinz E. Erblich. Published in *Automobiltechnische Zeitschrift*, April 10, 1934, p. 184. [L-1]

Cheap to produce and to operate, with a small engine and low car weight—these should be the principal objectives in the design of an automobile to offer to the general German buying public, according to the analysis here made. The proposed vehicle should not necessarily fall in the small car class, but should be a good-looking, complete vehicle, with a high quality of construction, material and performance.

L'Application des Essais en Soufflerie au Problème de la Résistance Aérodynamique des Vehicules

By M. Giqueaux. Published in *Journal de la Société des Ingénieurs de l'Automobile*, Feb., 1934, p. 2570. [L-1]

After justifying the wind tunnel as the means for measuring the wind resistance of automotive vehicles, the author describes a new elliptical wind tunnel, explains three methods for simulating ground effect and gives some results obtained from tests with locomotives and railcars.

La Résistance de l'Air et l'Automobile

By M. Andreau. Published in *Journal de la Société des Ingénieurs de l'Automobile*, Feb., 1934, p. 2577. [L-1]

Director of aerodynamic tests for the Chausson factory, the author describes some tests there made on Delage cars, using various bodies with various combinations of fenders, headlamps and so forth. The tests were made to determine, first, the unit coefficient of air resistance; second, the distribution of pressure and third, the effect of cross winds on general operation and stability.

TRACTOR

Le IV^{e} Concours International d'Appareils Chasse-Neige du Touring-Club de France (I^{er}—4 Mars 1934)

By Jacques Thomas. Published in *Le Génie Civil*, March 31, 1934, p. 285. [M-1]

In the Fourth International Competition for Snow Removing Machinery, the entries were divided into two classes, light and heavy, the latter being further subdivided into two classes. Descriptions are given of the 11 vehicles which participated, the results of the tests are reported and suggestions made for further improvements needed in this field.

(*Concluded on page* 48)

A Good oil seal

IS ESSENTIAL TO EFFICIENT BEARING PERFORMANCE

1

LEATHER PACKING MEMBER accurately formed to correct inside diameter and taper — the only element which can come in contact with the shaft.

2

WIPING LIP effectively prevents passage of lubricant or the entrance of foreign matter.

3

TENSION SPRING exerting pressure at wiping edge holds packing member on the shaft and automatically takes up any wear. Shaft contact is thus maintained even with shaft misalignment. Spring tension scientifically developed for speeds and pressures of the individual application.

4

OUTER CUP encloses the entire assembly in one solid unit for a close press fit into housing assembly.

5

INNER SHELL carries sharp bosses which penetrate the leather of the packing member to prevent its rotation with the shaft—an excluisve feature of the "Perfect" Oil Retainer.

6

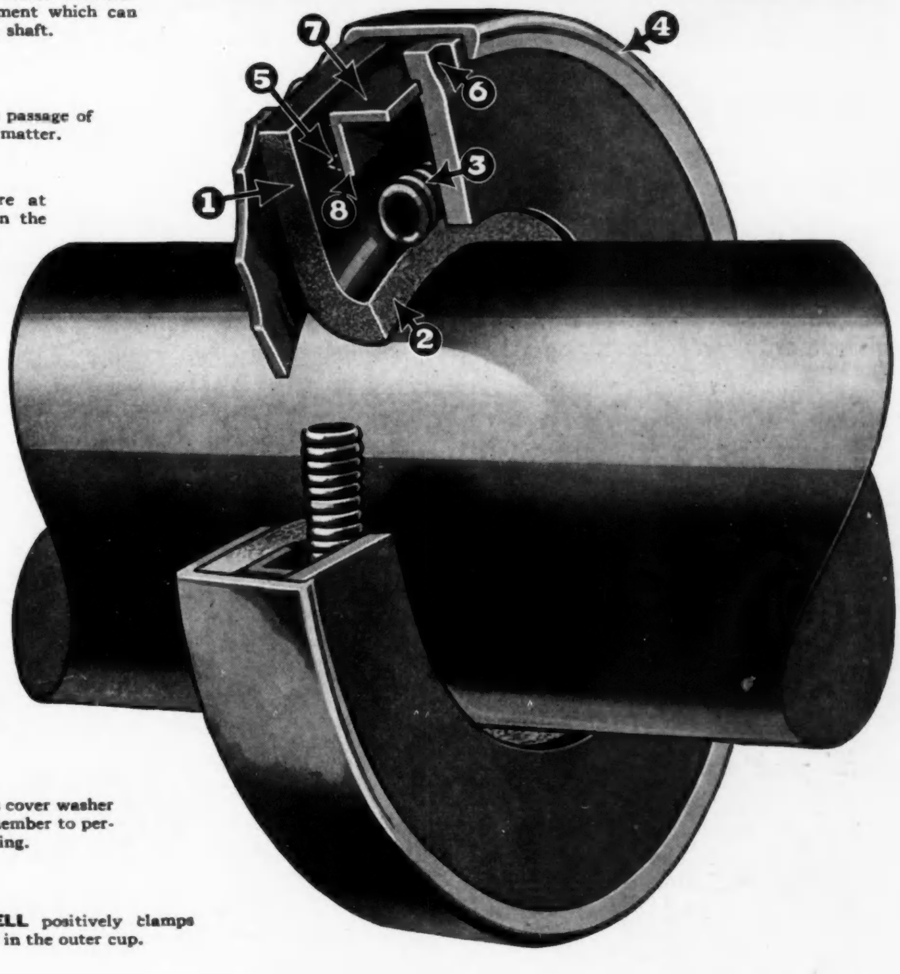
LUG on the cover washer drops into a notch in the inner shell to further prevent rotation of internal members.

7

INNER SHELL properly spaces cover washer and the flange of the packing member to permit free action of the tension spring.

8

FOOT OF INNER SHELL positively clamps flange of packing member in the outer cup.



PERFECT Oil Retainer

Every element illustrated here is manufactured by the Chicago Rawhide Manufacturing Company in its own plant and under its own complete control.

This seal is used on 89% of all automobiles and trucks built in this country and throughout the machinery industry where good bearing practice prevails.

Specify Chicago Rawhide "Perfect" Oil Retainers where long, economical bearing service is desired.

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NOTES AND REVIEWS

Concluded

AIRCRAFT

A Propeller-Vibration Indicator

By Hugh L. Dryden and L. B. Tuckerman. Published in the *Bureau of Standards Journal of Research*, May, 1934, p. 537. [A-1]

It is believed that fatigue failures of aircraft propellers, which occasionally occur, are due to resonant vibrations of the propeller or the propeller-engine assembly. This paper describes an instrument to be mounted on the end of the engine shaft for determining the engine speeds at which dangerous vibrations occur.

Speed and the Economics of Air Transport

By Major F. M. Green. Published in *The Journal of the Royal Aeronautical Society*, June, 1934, p. 449. [A-4]

Consideration is given to a logical basis for determining the most economical speed of flight. The methods discussed are engineering rather than strictly scientific. Much of the data used is the result of experience in design and many of the figures on which the results are based are derived from current practice. The author has not attempted to give an exact answer to the general question, viz., what is the most economical speed of flight, but rather to give an account of the method he has used in order that one can for himself calculate the economic speed of operation, using one's own knowledge and experience in making the assumptions necessary to the method. For the benefit of those less experienced, the author has included a number of tables showing the economic speed of flight for the estimation of which he used figures that agree with the best known current practice.

MATERIAL

Flow of Petroleum Lubricating Greases
Dependence of Apparent Viscosity on Temperature, Rate of Shear, Oil Viscosity, and Soap Content

By M. H. Arveson. Published in *Industrial and Engineering Chemistry*, June, 1934, p. 628. [G-1]

Petroleum lubricating greases, the author explains, are dispensed and used as lubricants under a variety of conditions in which the factors determining the flow characteristics are of primary importance.

Data are given at 77°, 50°, 25°, and 0° F. on a variety of greases using a constant-shear viscometer.

All of the data on greases containing calcium mixed-fatty-acid soap have been correlated into one general curve, in which the viscosity of the oil in the grease at the temperature in question, the soap factor K (determined primarily by the soap content), and the rate of shear are the primary factors determining the apparent viscosity of the grease. A relatively small correction is required for the effect of temperature on the soap factor. The agreement between the point data and the general curve is shown in the figures.

A mechanistic conception of grease structure and its behavior during flow is presented. The inability of Bingham's equation to apply to the data is demonstrated.

Peroxides in Gasoline
Peroxidation in Relation to Gasoline Composition

By J. C. Morrell, C. G. Dryer, C. D. Lowry, Jr., and Gustav Egloff. Published in *Industrial and Engineering Chemistry*, June, 1934, p. 655. [G-1]

In the work already presented (reviewed in the June issue of The Journal), it has been shown that cracked gasolines react with oxygen to form peroxides and other products, notably gum. To show to what components this reactivity is due, two methods of attack were followed: (1) The properties of the gasolines were determined after removal of conjugated diolefins and again after elimination of all olefin hydrocarbons; (2) the oxidizability of a number of pure hydrocarbons was studied by testing the hydrocarbons singly, blended with one other, and blended with gasoline.

The authors present the following conclusions:

1. The tendency of cracked gasolines to react with oxygen and form peroxides is attributable in part to conjugated diolefins and in part to other olefinic hydrocarbons. Removal of both produces a product extremely resistant to oxidation.

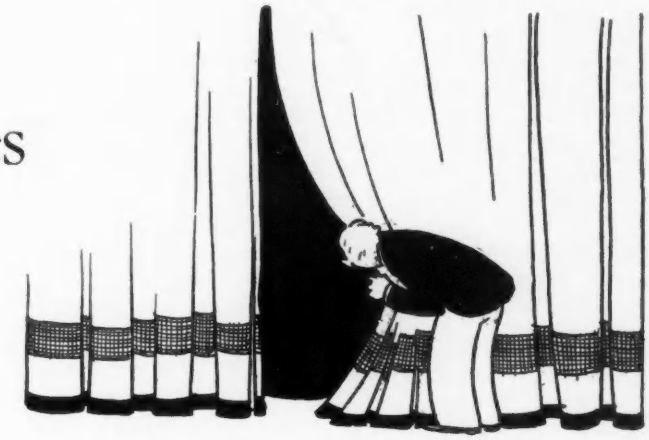
2. The tendency of olefins to form peroxides and also gum differs widely among different members of the series, and with any given olefin is greatly influenced by concentration. A gasoline may contain a high concentration of olefins and yet be very resistant to oxidation. In regard to gum formation, these results confirm those of Flood, Hladky, and Edgar.

3. Diolefins and olefins present together form more peroxidic compounds and more gum than when present singly in the same concentration.

4. Under the conditions employed, the oxidation of paraffins, cyclohexane, and aromatic hydrocarbons is zero or negligible.

Behind the Scenes

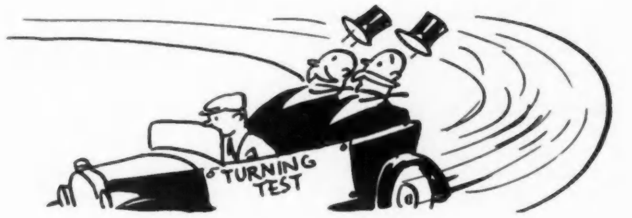
With the Committees



Highways Research

DURING recent months the Highways Research Subcommittee has been cooperating with the research staff of the Federal Coordinator of Transport, contributing such information as may assist the latter in formulating a policy of highway utilization.

Turning-direction indicators have also received considerable attention and a letter has been addressed to the chairman of the Lighting Division of the Standards Committee summarizing the Committee's comments on the specifications for testing turning-direction indicators developed by the Lighting Division.



Approval of the Research Committee has been given for publication of a statement outlining the consensus of opinion in the Highways Subcommittee with regard to the use of turning-direction indicators both from the viewpoint of highway utilization and equipment employed for accomplishing the purpose.

Extreme-Pressure Lubricants Research

FOLLOWING the development, at the Bureau of Standards under the sponsorship of the Extreme-Pressure Lubricants Research Subcommittee, of a research machine for testing the load-carrying capacity of extreme-pressure lubricants, several members of the Committee cooperating with the Chairman undertook the construction of a small machine with fewer controllable variables which it was expected could be built at a lower cost. A small machine of this type was constructed in the shops of the Studebaker Corp. Cost estimates were obtained, and a series of tests run at the laboratories of the Studebaker Corp., Standard Oil Co. (Indiana), General Motors Corp., and the Standard Oil Development Co. At each of these laboratories members of the Committee conveniently located were invited to inspect the machine and witness tests. The machine was later exhibited at Saranac and a film showing its method of operation was exhibited at the Bearings and Lubrication Session on June 20.

Results obtained in the preliminary tests were discussed at the meeting of the Committee on June 20, and while they were sufficiently encouraging to justify further development of the machine, a number of changes were considered desirable before additional machines are made available to members of the Committee who may wish to participate in a cooperative program of load-carrying capacity tests which is being formulated by a special subcommittee.

Re-design of the small machine is in progress, cost estimates for its production when completed will be secured and circulated to the Committee together with those available on the Bureau of Standards machine will provide members of the Committee with information from which to determine which type of machine they wish to purchase.

Front-Wheel Alignment Research

A PROPOSED code of basic instructions for wheel alignment has been formulated by several members of the Front Wheel Alignment Research Subcommittee. The first tentative draft has been revised in accordance with comments by the Committee and is now before the group as a whole for further consideration.

Chairman B. J. Lemon has continued the collection of wheel alignment specifications in passenger cars, trucks and buses. The compilation for 1934 models will soon be completed.

Ignition Research

THE Ignition Research Subcommittee which is in process of organization held its first meeting during the Society's Summer Meeting at Saranac Inn and heard a progress report on the experimental research at the Bureau of Standards on this project.

The undertaking was made possible last September by a contribution of the AC Spark Plug Co. and it is being carried out under the joint sponsorship of the Bureau of Aeronautics of the Navy Department and the Society.

The program to date has been concerned with the aviation

spark plugs. Mica spark plugs submitted by the leading makers of aviation plugs are being tested as to fouling and pre-ignition characteristics, and heat transfer between the shell and the center electrode is being studied. For engine tests of pre-ignition a water-cooled variable compression engine, a glycol-cooled fixed-compression engine, an air-cooled motorcycle engine and a high-speed outboard marine engine have been tried.

An extension of this investigation to other types of spark plugs and the development of some standard method of specifying the relative "coldness" of spark plugs is now under consideration.

Crankcase Oil Stability

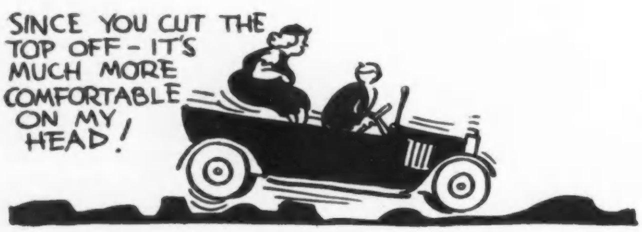
THE special committee appointed last October by the Crankcase Oil Stability Research Subcommittee canvassed more than a hundred equipment and lubricant manufacturers and commercial operators to obtain an unbiased appraisal of the importance from the service standpoint of the problem of crankcase oil stability.

In a report to the Crankcase Oil Stability Subcommittee at its meeting on June 21, this group states that a careful analysis of replies from 38 sources of information throughout the United States indicates that the majority is of the definite opinion that the problem is one requiring immediate attention, particularly from the point of view of development of necessary facilities for evaluating oils from the point of view of tendencies to crankcase sludge formation, ring sticking, acidity, and viscosity increase.

The report with recommendations for future procedure was approved by the Subcommittee and in turn by the Research Committee, and the special group is being continued with instructions to formulate a tentative research program.

Riding Comfort Research

THE importance of continuing the riding comfort research under Society sponsorship was forcibly brought out in discussion and written statements submitted at the Riding Comfort Research Subcommittee meeting on June 19.



As a means of clarifying any ambiguity which may exist concerning what is involved in the riding comfort measurement problem, it was resolved to formulate a fundamental definition which will in fact be a performance specification to be met by all acceptable means of measurement.

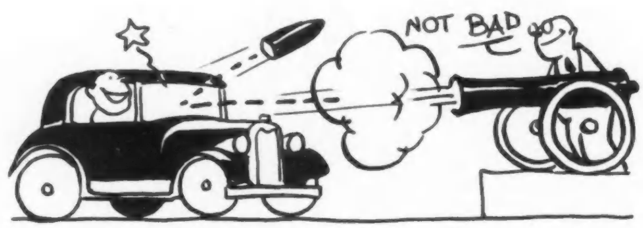
The need for correlation of the "human element" portion of the problem, as developed by the work of Dr. F. A. Moss, with the "mechanical element", as brought out in other phases of the work accomplished to date, was emphasized. The Committee, largely through its chairman, Ray W. Brown, of the Firestone Tire & Rubber Co., is contacting with persons and organizations believed to be interested to ascertain whether the suggested correlation work is of sufficient importance to justify general participation and financial support.

A compressible seat-cushion method of measuring the forces to which the motor car passenger is subjected was explained and demonstrated by M. L. Fox, General Motors Proving Ground, at the Summer Meeting.

Safety Glass for Motor Vehicles

FOR several years the passenger-car division of the Standards Committee has felt the need for a uniform specification for methods of test for safety glass used in motor-vehicles. Little could be accomplished, however, because of the rapid development of this product and the more recent introduction of the so-called heat-treated or case-hardened glass. This project was recently taken up under the American Standards Association procedure and a Sectional Committee appointed to draft a code for specifications and tests for safety glass, due to the present need in the automobile industry.

For uniformity of practice in the manufacture and in the use of this glass, largely because of regulatory action taken by the states, a subcommittee of the Sectional Committee, on both of which the Society is well represented, has been rapidly developing test specifications for the various types of safety glass.



In order to assure the motor-vehicle manufacturer ample opportunity to be familiar with this code in its formative stages and to cooperate fully with the sectional committee and subcommittee, the S.A.E. Advisory Committee on Safety Glass organized under the auspices of the passenger-car division of the S.A.E. Standards Committee, representing 11 passenger-car manufacturers, 4 truck and bus manufacturers and 3 body manufacturers who have reviewed the draft codes and passed along the recommendations to the subcommittee of the section. It is probable that the completed draft of this code will be available soon for review by the entire automotive industry before its final approval as an American Standard Code.

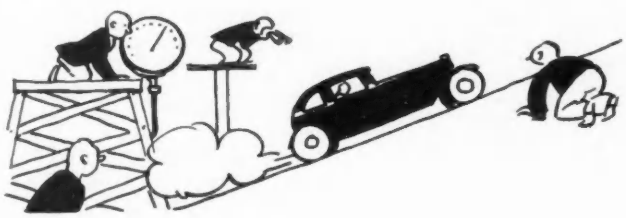
Automotive Storage Batteries

ONE of the more important revisions in S.A.E. Standards to keep abreast of current car designs is that for motor vehicle storage batteries. The new specification includes four general types of batteries for use in passenger cars as well as types for use in motor trucks and in motorcoaches. At a special conference at Saranac Inn, N. Y., on June 17, just prior to the S.A.E. Summer Meeting, an important side step was taken by eliminating the 20-minute ratings that were a carry-over from earlier practice and are

now superseded by the 300-ampere, zero deg. fahr. standard rating. An important addition to the standard is notes and instructions and a description of the necessary apparatus to provide uniform equipment and methods for testing automotive storage batteries.

C.F.R. 1934 Road Tests

A SECOND series of cooperative road tests, under the direction of the Cooperative Fuel Research Steering Committee, was started on July 9 at Uniontown Hill, Pa. These tests have been undertaken, first, to determine the



degree of correlation which exists between laboratory knock ratings of representative fuels by the "Tentative Method of Test for Knock Characteristics of Motor Fuels" (A.S.T.M. Designation: D357-33T) and ratings of the same fuels in current models of cars on the road; and second, since cars differ considerably in the ratings given to sensitive fuels, to help throw light on the specific reasons for these differences and suggest how the difficulty of depreciation may be overcome.

The Committee is gratified to have four foreign participants in the tests: R. Stansfield, Anglo-Persian Oil Co., Ltd., and C. H. Sprake, Anglo-American Oil Co., Ltd., both delegates from the Institution of Petroleum Technologists of England; Claude Bonnier, Chef du Service des Essais, delegate of the French National Office of Liquid Combustibles; and L. Helliwell of Imperial Oil Refineries, Ltd. of Canada.

Eighteen United States organizations, including the Bureau of Standards and Yale University, are actively participating in the tests. The Society's Council granted a special request of the C.F.R. Committee to make available the services of C. B. Veal, S.A.E. Research Manager and Secretary of the C.F.R. Committee, in order that he might undertake the secretariat of the test project and serve the Committee in the same capacity as he did during the 1932 road tests.

Motorboat Shaft and Wheel Hubs

SOME years ago the Motorboat Division of the Standards Committee developed standard propeller shaft ends and propeller bores for motorboats, shaft sizes ¾ in. to 3 in. The division this year reviewed this old specification and has reported a revised specification that is more complete and covers the types used for shafts up to 8 in. diameter.

Research Executive Committee Formed

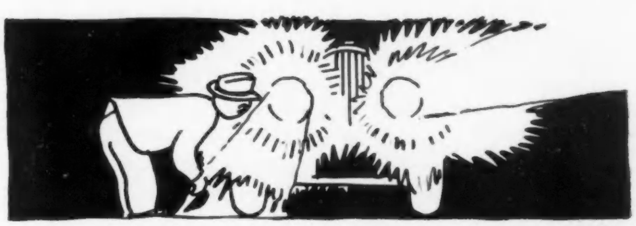
AS previously reported in the JOURNAL the Society's Council at its March 14 meeting created a Research Executive Committee to be under the chairmanship of the chairman of the Research Committee and to include in its membership the chairmen of various groups falling within the scope of the Society's research work.

The need for a small working group, to decide matters of procedure in connection with the research work at more frequent intervals than it is practical for the entire Research Committee to come together, has arisen as a result of the growth of the Research Committee and the expansion of its activities, through an increased number of projects and subcommittees, increasing both the size of the Committee and the detail involved in carrying on the projects.

The Executive Committee at its first meetings at Saranac Inn on June 17 and 18 outlined a general policy and procedure to be further developed as a result of study and discussion by its members.

Reflex Reflectors Specification

AFTER a rather long series of tests conducted jointly with the Illuminating Engineering Society and with the cooperation of state regulatory officials, a more complete and up-to-date specification has just been adopted by the Society in a revision of the present recommended practice of the Standards Committee appearing on p. 604 of the 1933 S.A.E. HANDBOOK. The present changes are in the photometric requirements and procedure in testing. The



complete new specification will be issued in the new supplement to the S.A.E. HANDBOOK mentioned elsewhere in these columns.

Supplement to 1933 S.A.E. Handbook

A NUMBER of revised or new S.A.E. Standard specifications will be published in a supplement to the 1933 edition of the S.A.E. HANDBOOK, that is now in the hands of the printer. Among these specifications the more important revised ones include, automotive storage batteries, automobile electric headlamps including the asymmetric type, a new specification for reflex reflectors for use on the tail-end of trucks and buses and extensive revisions in the brass, bronze, copper and aluminum specifications. A new standard of major importance is that for twist drills sizes 1/64th to ½ in. inclusive which represents a very substantial reduction in the previous number of drills of this range of sizes.

S.A.E. Production Meeting Coming

THE Production-Activity Committee announces that an S.A.E. Production Meeting will be held in Detroit on Oct. 10 and 11. The program includes a cutting-oil session, a dynamic-balancing session, a broaching-practice session, and a production dinner with the Detroit Section cooperating. A speaker of national prominence in production will be on the Dinner program. The Committee will announce the full program at a later date.

A Critical Study of Car Design and Performance

(*Continued from Page 17*)

that when operated without the special cooling, it was necessary partially to close the throttle to prevent detonation. Greater output will be possible if these phases can be accomplished commercially.

Aluminum heads and/or higher compression ratios have shown a lowering of the exhaust temperature and the exhaust valve would benefit thereby.

Ignition

The new AC 10 mm. spark plug has been brought out due to its better temperature stabilizing ability and facility in keeping its insulator cleaner from carbon. The initiation of combustion is being carefully studied and it is probable that some of our recent theories will be changed. In some heavy duty bus service, two different plugs are used in each cylinder, a type D-8 AC plug being used opposite the intake valve and a D-4½ (cooler), opposite the exhaust. Such a practice may be reflected into the future passenger car engine of high output. High speed miss has been traced to stagnant gas at the plug points. Considering the wide variations in

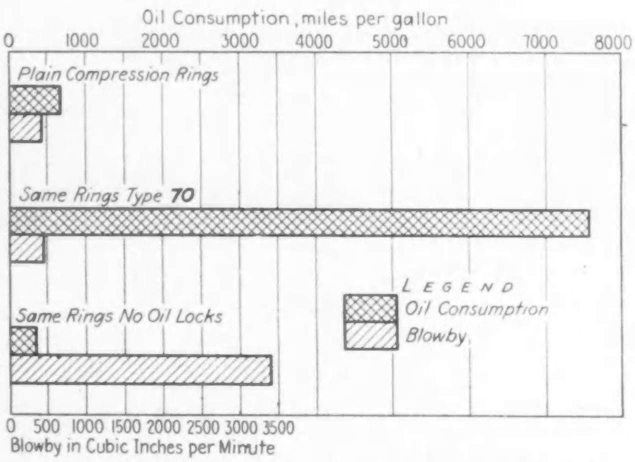


Fig. 8—Piston Ring Tests for Oil Consumption and Blowby

speed, turbulence and stratification vary widely and the two-plug construction will partially overcome this condition.

Ignition timing for high compression engines is more critical than for those with low compression. Some manufacturers permit a maximum variation in the distributor of 1 or 2 deg. from the predetermined timing curve yet permit a backlash of 10 to 12 deg. in the distributor drive. This phase would bear improvement.

The rough surface of the plug electrodes permits the spark to jump the gap at a lower voltage. The point discharges from the uneven surface ionize the gap space, making it a better conductor. Since it is impossible in service to keep the points rough, a recent German patent to Bosch excites interest. The electrodes are formed from a mixture of metals having high and low volatilizing temperatures, the more easily melting element being consumed while the other remains unattacked resulting in crater-like depressions.

Carburetion

The Cadillac cold-air intake provides air at the carburetor inlet about 100 deg. cooler at full throttle running and the difference would be less at part throttle due to the decreased air velocity. At idling there would be practically no difference. Assuming an outside temperature of 50 deg., the under-hood temperature around the carburetor inlet would be about 160 deg., the temperature rise through the cold-air intake being about 10 deg. The air entering the carburetor will have a temperature of 60 deg. Without the cold-air intake the absolute temperature would be 619 deg. and with it 519 deg. The theoretical density would be increased 16 per cent. Fifteen per cent would be a safe figure allowing for restrictions in the piping. The 1934 V-12 shows an increase of 29 hp. at the peak over the 1933 or a gain of 23.6 per cent. It might be assumed that a difference of 8.6 per cent is due to the higher compression which however has been made partly possible by increased octane rating of the fuel and because of the cooler air used.

Tests at the Standard Oil Development Co. indicate that a number of the 1934 cars are designed up to the limit which is permissible for 70 octane gasoline. As a result carbon knock appears sooner after cleaning the engine than in some of the previous models. The accumulation of carbon is a problem in high compression engines. The coating of low thermal conductivity on the combustion chamber walls increases surface temperatures, lowers the volumetric efficiency and permits detonation and self ignition. Due to the small clearance volume, the compression ratio is increased by the accumulation. The injection of a carbon binder solvent which has only been used on a few models in the past, looms as a future necessity. Slower and lighter accumulation of carbon deposits have been found with aluminum heads and they deserve consideration on this issue.

To those interested in fuel utilization, Fig. 10 is offered which shows the heat balance of a small 8-cylinder engine in the laboratories of the Ethyl Gasoline Corp. It is interesting to note that high compression engines show a greater percentage of the fuel energy being converted into power, leaving a smaller amount for dissipation in the exhaust and cooling systems.

There has been a great deal of interest in supercharging, and the ability of the rotor to break up the fuel particles is very beneficial particularly in cold starting. We can expect its further adoption.

Electrical Equipment

Increased generator output is one of the features of the year and it has been necessary to step up the performance without resorting to larger sizes. What has been accom-

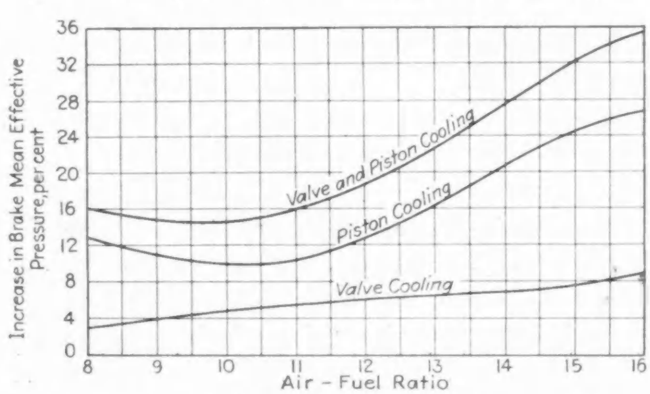


Fig. 9—Effect of Abnormal Cooling of Piston and Exhaust Valve

plished along this line is disclosed in Fig. 11 which gives a performance curve of the 4½ in. Auto-Lite generator, type GAR. The output is given both hot and cold with ventilation and also the same type generator without it. The cold curve is the performance at room temperature or approximately 74 deg fahr. The hot curve is taken at maximum temperature with the generator running in dead air. This is much hotter than any normal under-hood temperature.

The extreme weather of the last winter brought cold weather starting failures and their correction into great prominence. Thanks to the educational work inaugurated by the Lubricants Division, the public became familiar with the new 10-W and 20-W oils. The important phase of the use of light oil is not the increased cranking speed but the reduced friction hp. which ideally should be lower and practically not much higher than the developed engine hp. so

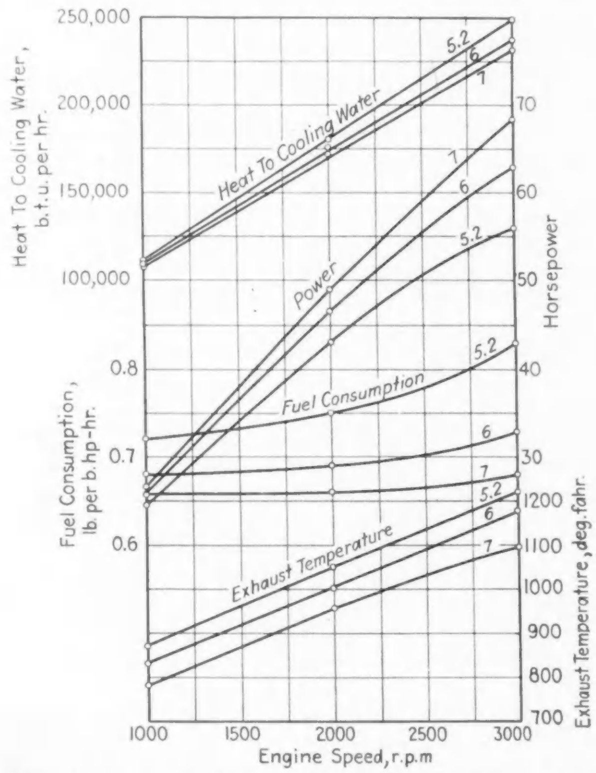


Fig. 10—Effect of Compression Ratio on the Heat Balance of an 8-Cylinder Engine

that it will continue to run after the first explosion. The friction hp. of some of the later engines with small cylinders, tight-fitting rings and tight bearings has not received enough attention on the score of low temperatures. Fig. 12 shows the friction and developed hp. in tests conducted for the Eclipse Machine Co. of a 3⅛ in. x 3½ in. 8-cylinder engine that had seen several thousand miles of service. The tests were made at 0 deg. fahr. and the developed hp. is shown by the full line. The broken lines show the friction hp. of the engine using S.A.E. 20 oil, S.A.E. 10 oil, and S.A.E. 10 oil diluted with 10 per cent kerosene (about the equivalent of 10-W). If the friction hp. is held down, no difficulty is experienced with failure of the engine to continue running after the first explosion. The high friction hp. which cancels the developed hp. is also responsible for making the Bendix pinion demesh several times with subsequent failure of the engine to continue running in cold-weather starting and is not attributable to the starting equipment, insufficient cranking speed or car-

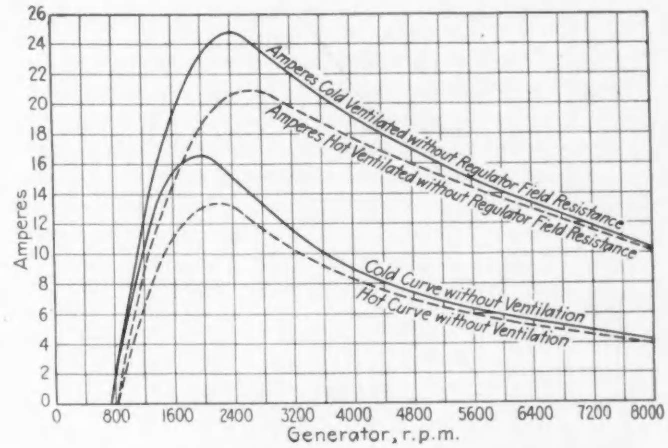


Fig. 11—Hot and Cold Auto-Lite Generator Output With and Without Ventilation

buretion. It is possible that with the more general use of the lighter oils, smaller or lighter starting equipment might be possible. Many of the manufacturers are now recommending the light oil for new engines even under summer conditions and increased hp. and car speed resulting from light oil and its effect on engine friction is being recognized.

The Eclipse Machine Co. has just concluded an interesting investigation on ring gear hardness and its relation in preventing the end-to-end mesh condition or "lock-up" of the Bendix drive with reference to the ring gear. For a good many years the recommendation with respect to the hardness of ring gears at the meshing edge has been specified as between 50 and 60 scleroscope. Taking readings with the scleroscope on the chamfered end of the flywheel ring gear teeth, which are approximately 1/16 in. in width, is rather difficult due to the small area presented to the diamond. More consistent results have followed by the use of Rockwell readings at this point, and at the present time, the Eclipse recommendations to ring gear manufacturers and engine builders is that this hardness be kept between a Rockwell reading of C-39 to C-46 for use with 8/10 pitch pinions. For ring gears for use with 10/12 pitch pinions they are recommending a hardness of C-42 to C-48. A few years ago hardnesses such as these were considered difficult to maintain because ring gears then as at the present time were made from S.A.E. 1045 steel. Improvements in heat-treating methods and ability to obtain steel without decarbonized surfaces make it entirely

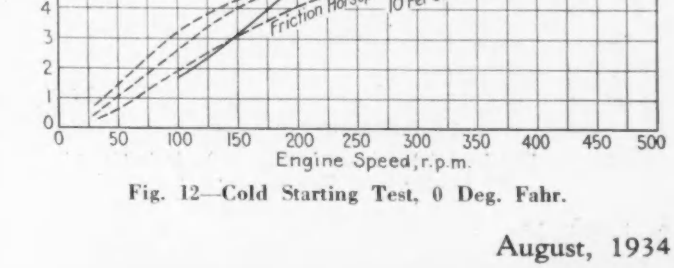


Fig. 12—Cold Starting Test, 0 Deg. Fahr.

feasible for the maintenance of the hardness readings outlined above.

In the course of the work of Eclipse with 10/12 pitch pinions, considerable data on the performance of ring gears of various hardnesses was accumulated. Fig. 13 was obtained by plotting against ring gear hardness the point at which the first tight end-to-end mesh or "locked up condition" occurred (EET). Naturally these points do not fall on a line, but there are indicated two lines representing a band in which the data obtained to date consistently falls. Referring to this chart it will be noted that with a Rockwell hardness on the teeth of C-35, the first end-to-end may be experienced anywhere from 13,000 starts to 37,000 starts. With a hardness of C-40 the point at which this first end-to-end occurs may be anywhere from 40,000 to 65,000 starts. With the hardness at C-45 this point is raised to a value between 80,000 and 110,000 starts. At the lower hardness readings results do not seem to be quite as consistent as at the higher hardness readings, but within the ranges recommended, i. e., C-42 to C-48 very consistent results have followed, and in production these hardnesses are being maintained without any particular difficulty.

Cooling System

Due to the limited space available it has been necessary to concentrate the cooling surfaces, with the result that considerably more capacity has been built into a given space. This had to be accomplished without increasing the resistance to air flow through the core and also without seriously affecting the free flow of water through the core tubes. Practically all manufacturers of automotive radiators have improved their cores along this line and during the last two years there has been at least 10 per cent improvement in heat transfer per unit area. Water loss problems due to greater pump capacities, have required not only more elaborate baffling in the radiator top tank but the additional means of checking losses through the vent pipe. This has been done by positioning the vent opening in the top tank where it is least exposed to the surge of water both from rapid stops and from acceleration of the vehicle. Various means of restricting this opening to the vent pipe have been used even to the extent of completely

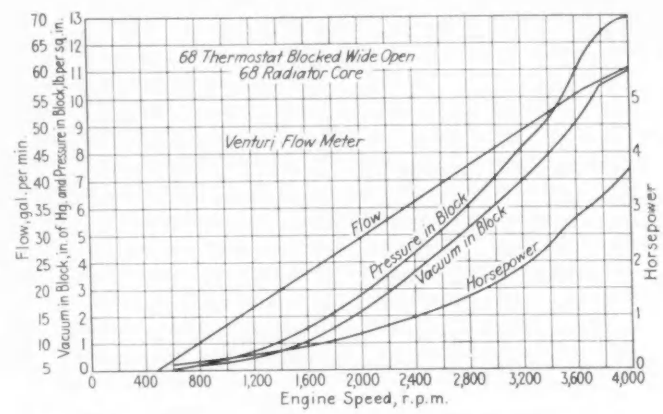


Fig. 14—Cooling System Data on Graham Model 68 Engine

closing the system with the exception of a relief through a spring-loaded valve. Valves of this nature are being given serious consideration at the present time and when used permit a slight pressure to exist in the water system during the greater portion of the time the car is in operation. Streamlining of bodies presents quite a problem for proper cooling; the amount of air available has been reduced by the tendency to sweep the air away from the front of the car rather than permit it to pass through the radiator core. The space to the front of the engine, usually the most satisfactory position for the radiator, is greatly reduced with regard to height, making it necessary for more efficient cores per unit of face area.

It is my personal opinion that many of today's radiator designs are less beautiful than the designs of 1933.

The suppression of fan noise as well as other undesirable noises is still a problem. The fan must be designed for the particular model, taking in the complete car because the whole acoustical set-up must be balanced and the fan designed to blend with the noises of the other parts so that there is no disagreeable, predominant frequency. The work of the Automotive Fan & Bearing Co. is well known along this line in which the blades are unequally spaced. Table 4 is a summary of their present-day production. The unequal spacing has given a new control of the frequencies involved in fan noise, while proper blade shapes and tip speeds have been instrumental in reducing the noise intensity.

The circulation of water and power requirements are shown in Fig. 14 of the Graham-68, their 6-cylinder $3\frac{1}{4}$ in. x $4\frac{1}{2}$ in. The vacuum was measured $6\frac{1}{2}$ in. from the center of the water pump and the pressure was measured in the top of the cylinder head 23 in. back of the center of the water pump.

Clutch and Transmission

The prominent improvement in present-day clutches is in reducing pedal pressures by using needle bearings or knife fulcrums and increasing capacity and life without going into larger sizes. With the higher engine revolutions, better running balance is essential and the Long Mfg. Co. balance their units to within the 0.2 oz. in.

The centrifugal automatic clutch has not made any headway. The Bendix automatic clutch control has been considerably improved by the use of the compensator which causes the clutch control to cushion or cut off at the instant the clutch plates make contact. The success of this device is absolutely dependent upon a constant friction of the clutch operating parts and has been very successful when used with the Borg & Beck knife-edge design.

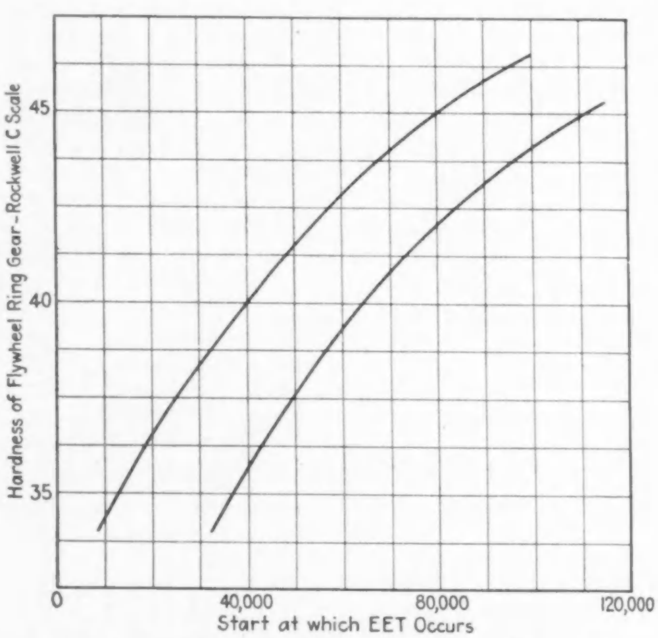


Fig. 13—Flywheel Ring Gear Hardness in Relation To Starter Gear Engagement

The fluid flywheel is intriguing. Many of us no doubt recall the Radcliff clutch which antedated all of the foreign developments. I believe it has possibilities and might be utilized before the advent of a more flexible ratio transmission. The present-day engine has considerable flexibility in itself and it is doubtful whether an infinitely variable transmission is necessary.

There is considerable controversy over a fully automatic transmission and S. O. White of the Warner Gear Co. has expressed himself very fully on the subject. It is his contention that the overdrive transmission really does more for the automobile than what a purely automatic one would do. He considers the latter in the luxury class, doing practically nothing for the economy and performance of the car whereas the overdrive is a tremendous help both as to economy in addition to adding greatly to the comfort of driving and lessening of fatigue from vibration on long drives.

The upper illustration of Fig. 15 shows the Chrysler overdrive which is standard on the airflow Imperial and optional on the Eight. At speeds above 40 m.p.h. free-wheeling is automatically cut out by the overdrive operation. When the accelerator is released for the length of time necessary to allow the engine speed to drop sufficiently, a pair of pawls move outwardly to engage a shell in which the planetary gears are axially mounted. The sun gear is held stationary through a vibration damper mounted at the front of the unit to cushion and quiet the drive. An internal gear conveys the power to the main shaft. All gears are helicals. The other example of overdrive is the Auburn axle shown in Fig. 15, with vacuum-piston actuation of the clutch to select the ratio. The clutch is now provided with a synchronizer. Chrysler provides a 0.705 to 1 overdrive; Auburn a 0.666 to 1 and 0.675 to 1 on the small and large axles respectively.

Table 4—Fan Data
Automotive Fan & Bearing Co.'s Units

Make and Model	Blade Spacing, Deg.	No. of Blades
Buick—8. 80-8. 90	70 & 110	4
Buick—8. 60	70 & 110	4
Continental	76 & 104	4
Chrysler—6	70 & 110	4
Chrysler Airflow	70 & 110	4
DeSoto Airflow	70 & 110	4
Plymouth	70 & 110	4
Cadillac LaSalle	70 & 110	4
Packard—8	70 & 110	4
Packard—12	60 & 120	4
Lincoln—12	60 & 120	4
Cadillac—V8	60	6
Cadillac—V12 and V16	65, 65, 92½, 45, 92½ deg.	5

Universal Joints

High rotative speed also affects the universal joints and propeller shafts which must operate in some cases at speeds over 4000 r.p.m. This means that every part of the joint and shaft must be in good dynamic balance. We find that from the crankshaft back to the rear axle the whole train of high-speed rotating parts require extreme care in balancing which some day will call for the balance of the entire assembly line. The Mechanics universal joint is an example of extreme pre-

Fig. 15—Chrysler and Auburn Overdrives

cision in the quest for balance. All parts are machined except for some small areas near the center of the joint.

Concentricity must be maintained easily and accurately so that the shaft proper will run on correct centers. Long shafts are very often the cause of rough running. It is not a stretch of imagination to state that a shaft can be so sensitive to unbalance that a smear of mud on one side of the tube will create a disturbance at maximum speed.

Cadillac and Chrysler have kept the propeller shaft within a reasonable limit by providing an extension at the rear of the transmission. The use of the needle or roller bearing has increased the efficiency, capacity, life and dependability of joints. The Mechanics Universal Joint Co. states that comparative efficiencies between their roller bearing joint and another design show the following losses: 0.2 per cent at 5 deg. to 10 deg. and 0.4 per cent at 15 deg. The loss varied directly as the load and speed had no effect. The other design tested at the same time showed a loss of 0.8 per cent at 5 deg., 1.1 per cent at 10 deg. and 1.8 per cent at 15 deg. A considerable difference in operating temperature and wear were perceptible, being very great under relatively high torques and angles. Plain bearing universals have high efficiency at small angles so long as lubrication is adequate, but the power loss increases rapidly as the angularity increases and becomes very high if unit pressures become great enough to cause a partial breakdown of lubricant film.

Rear Axles

With individual front wheel suspension, the question arises of how soon application of such suspension on the rear will occur and relegate the conventional rear axle to the past. A real saving in weight is possible which has not occurred at the front end. An experimental design in Fig. 16 shows the frame mounted differential unit in which the pinion shaft is made longer than usual to permit the shortening of the propeller shaft, in line with the Cadillac method excepting that the elimination occurs at the differential unit instead of at the transmission. The powerplant and the pinion shaft can be set at an angle so that both universals operate at like angles and at the same time places the propeller shaft low in the chassis to avoid a tunnel in the car body floor. The roller bearing universal makes such a DeDion system possible as contrasted to the plain bearing construction.

The hypoid gear has made further headway. The increased size of the pinion allows the use of a larger reduction than with the same size spiral bevel. The lower propeller shaft position that is permissible gives greater body clearance. A recent test completed by the Gleason Works on the comparative life of the hypoid and spiral gears is given in Appendix B which clearly shows superiority of the hypoid over the equivalent spiral bevels from the standpoint of strength and fatigue life.

The fully sealed New Departure bearings used in the Oldsmobile-6 axle aim to reduce the necessary servicing and their performance is being watched with keen interest.

Brakes

The hydraulic brake is making further advances and its adoption by Oldsmobile and LaSalle is particularly interesting.

Cross shaft distortion has been eliminated in the General

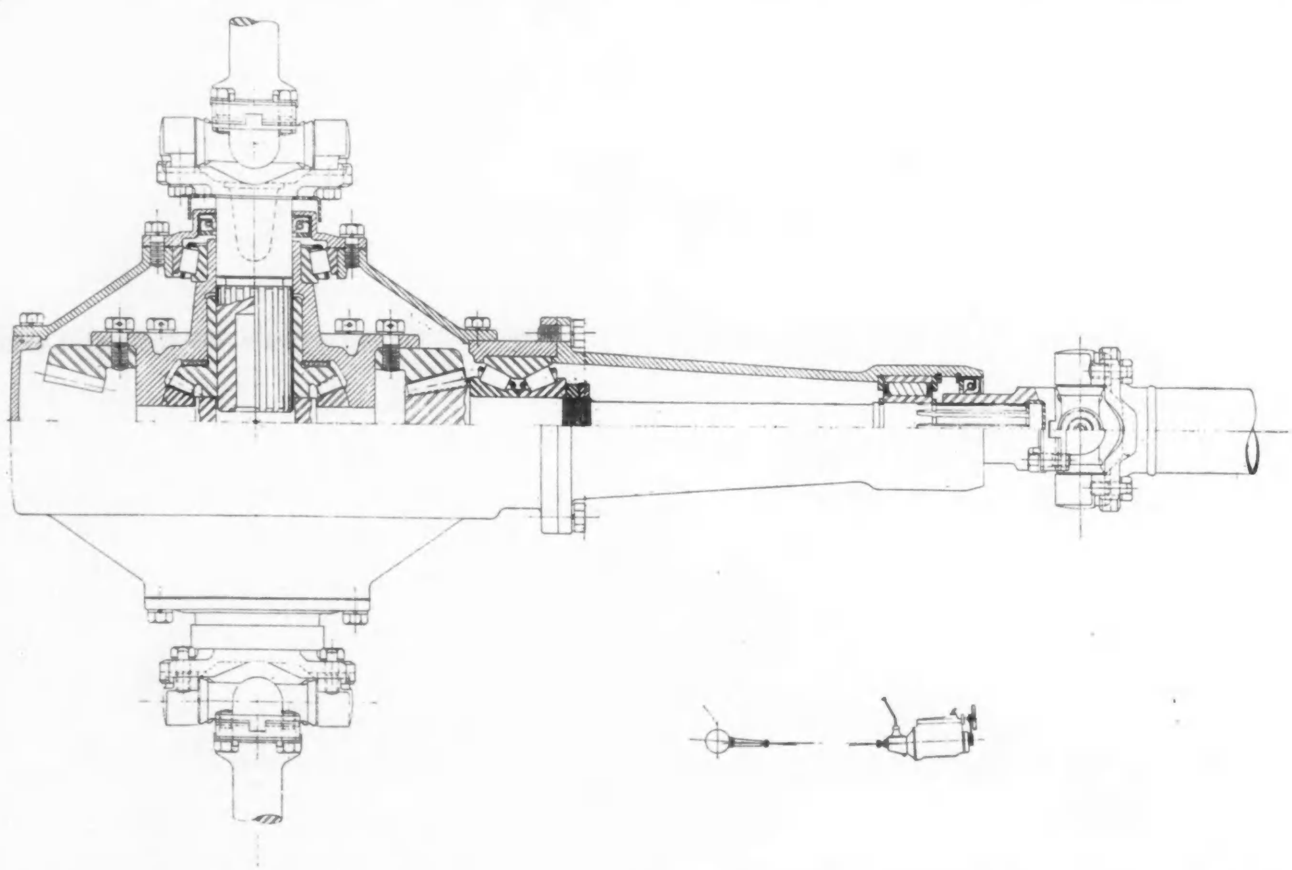


Fig. 16—Experimental Design for Individual Sprung Rear-Wheel Drive

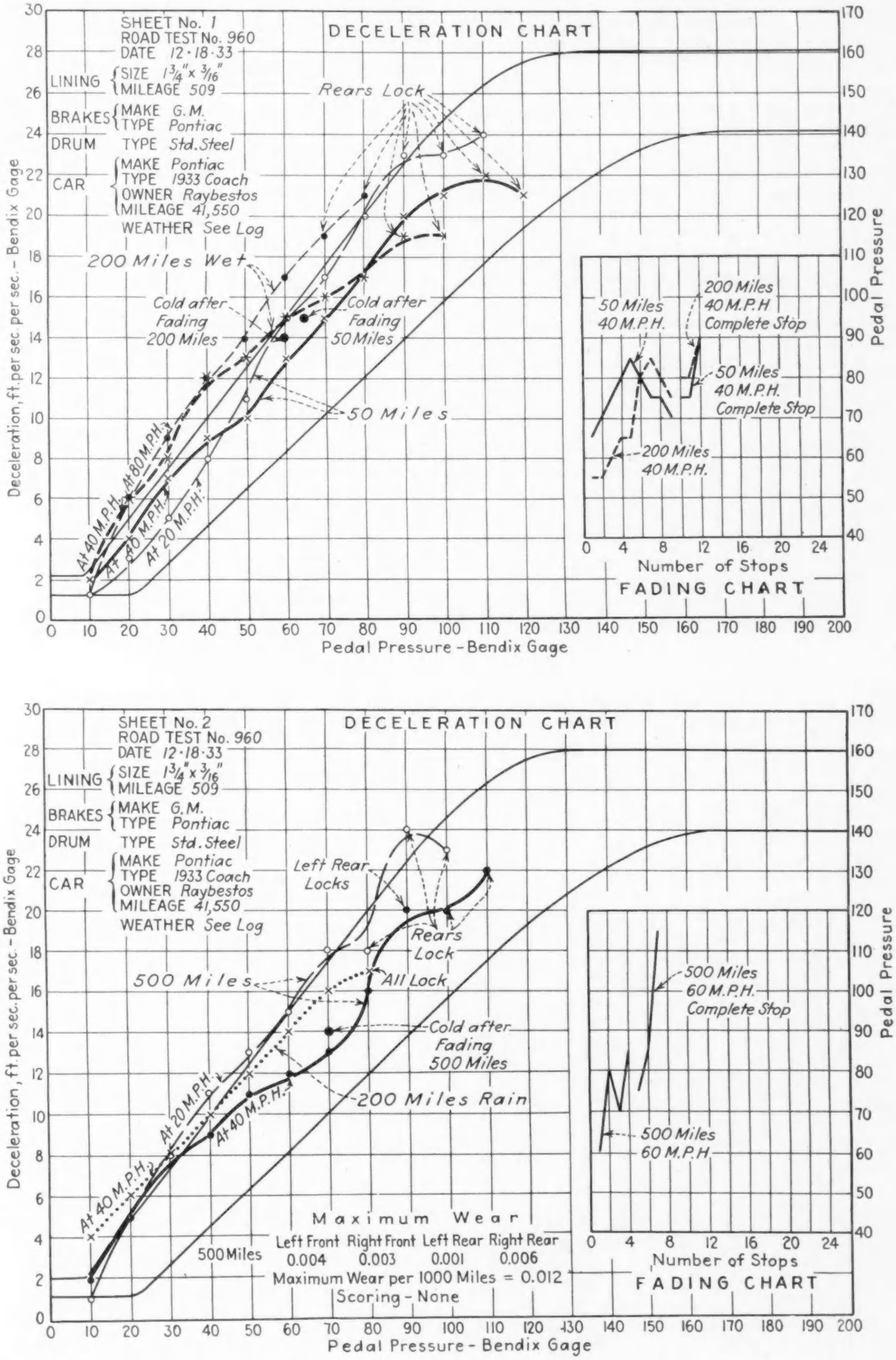


Fig. 17—Deceleration Tests Made by Raybestos Co.

Motors group using mechanical brakes by the use of very short shafts which design was inaugurated by Ford. The brake rods extend diagonally to the cable connections of each wheel brake.

Most engineers are not satisfied with tests of brake lining not made on the road and a method of visualizing the results of road tests such as are shown in Fig. 17 form a new basis of test comparison. These tests were made by the Raybestos Co. The long diagonal lines set the limits of effectiveness that have been recommended. It will be noted that the upper limit becomes flat with a deceleration of 28 ft. per sec. per sec. and 130 lb. pedal effort, while the lower becomes flat at 24 ft. per sec. per sec. and 170 lb. pedal effort. Fading tests are made by applying brakes to get a constant deceleration from 40 m.p.h., for example, 15 ft. per sec. per sec. and recording pedal effort on ten to twenty separate brake applications made about 20 sec. apart from this speed—40 m.p.h. Fading is expressed by a curve tracing the increasing pedal effort to get the required deceleration.

Suspension

The desire to obtain a better ride has resulted in front individual wheel suspension in which the deflections have been reduced to as low as 105 lb. per in. The means of obtaining this by the extension of conventional construction is exemplified in the Chrysler and DeSoto. The other method is the use of individual wheel suspension of the General Motors group, Dodge and Plymouth. Due to the greater sensitivity toward sidesway, a stabilizer is used in all these vehicles with the exception of the Chevrolet.

The requirements of individual wheel suspension has called for considerable bracing of the frame in the parellel link type due to the high moment placed on the front cross member when meeting obstructions. None of the individual wheel suspensions truly take care of the horizontal component of road shock which also exists in the conventional design.

Delco Products has developed a new Dubonnet suspension for cars of 3500 lb. to 4000 lb. weight. The construction utilizes a horizontal spring and a shock absorber within as shown in Fig. 18.

The new Buick-40 uses a somewhat lighter and simplified design of upper wishbone construction. It is made from one forged arm and a punched sheet steel arm. The shaft, which is of hardened steel, bears directly on diamond bored cast-iron bearings instead of bronze. Some recent tests were made comparing the results of driving a car having the new wishbone suspension into a wall at about 45 deg. with speeds of 10 to 20 m.p.h. with the same weight of car having a conventional front end. Although both cars were somewhat damaged, the hinged independent construction from the owner's standpoint, was considerably easier to repair and place in operating condition. The tests were made to settle the question about the relative merits of the independent suspension compared to the previous models in case of accident.

Wheels and Tires

With the small wheel diameters now being used, the stamped steel wheel is considerably favored. There are hardly any two wheels alike in design as the question of appearance has an important place in the design. Weight is also vital and

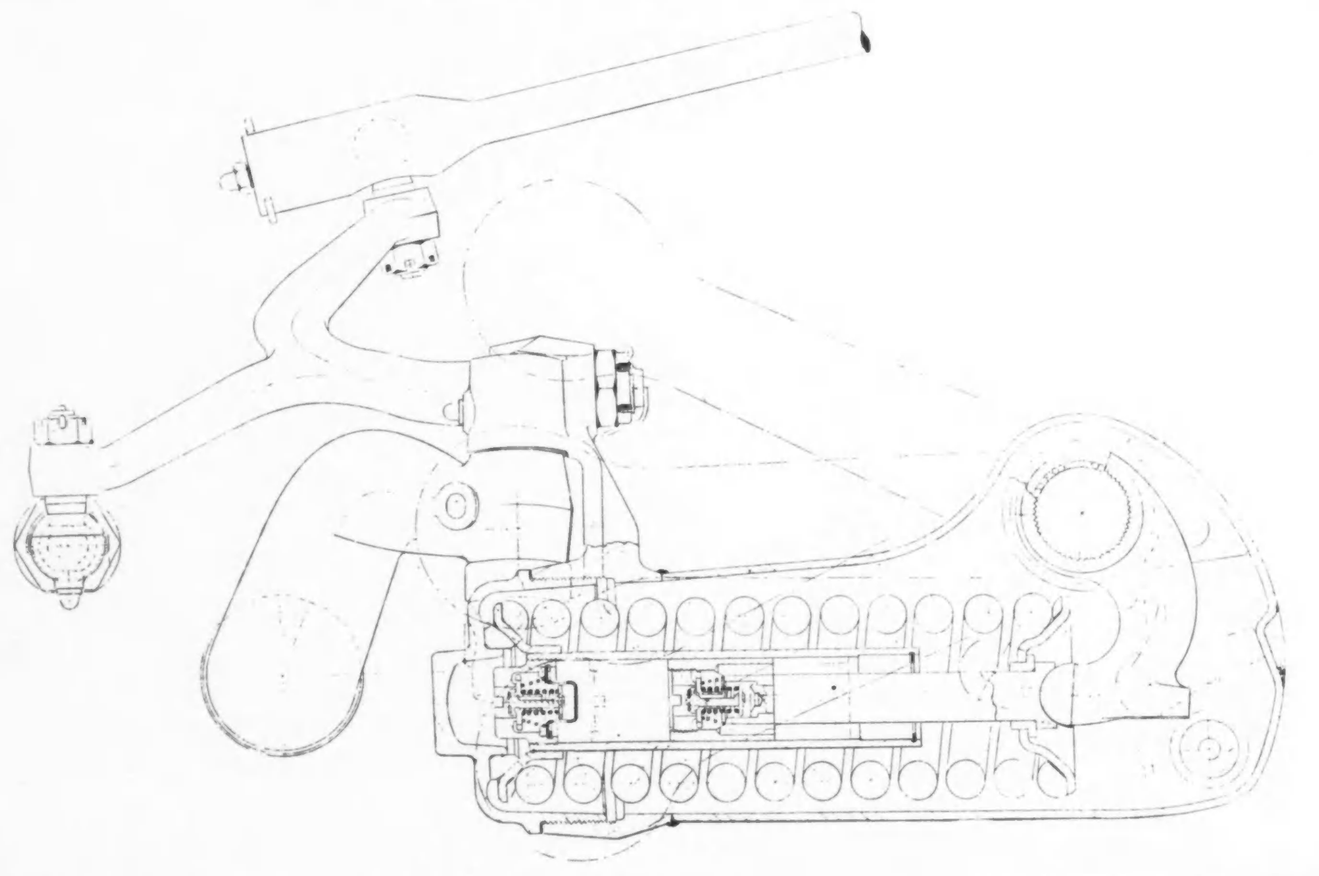


Fig. 18—Delco Horizontal Type

is being reduced each year. The double disc type of wheel, used on Plymouth and DeSoto, has an inner disc acting as the load-carrying member and the outer disc made of cold rolled steel is used mostly for appearance. They are of the hole type. A spoke type of double disc construction is used on the Buick, the larger Chrysler, Hupmobile and Reo. The single disc spoke type is used on Oldsmobile and Hudson.

Tires are subjected to a greater camber in the parallel link type of construction when making a turn but since this occurs only a small portion of the time, tire wear is not excessive. The greater engine output, with the trend toward superchargers, is subjecting the driving tires to considerable abuse.

Frame

While European attempts have utilized a hollow tube as a backbone, the unit frame and body construction seems to hold greater possibilities in the way of a load-carrying member of maximum torsional rigidity.

The new Buick-40 frame is provided with a front cross member that extends beyond the coil springs and locates the rubber bumpers which limit the rise and fall of the wheels at the extreme end. Side rails pass through the cross member inside of the coil springs, making a simple and most rugged construction.

The bracing of the frame to take care of the independent front wheel suspension is well indicated in a comparison between the Chevrolet Master and Standard frames. Oldsmobile and Pontiac are provided with a cross member immediately ahead of the bell housing in order to tie the side rails together at this point. All of the General Motors X-Member Frames have bracing between the X and the side rails.

Control

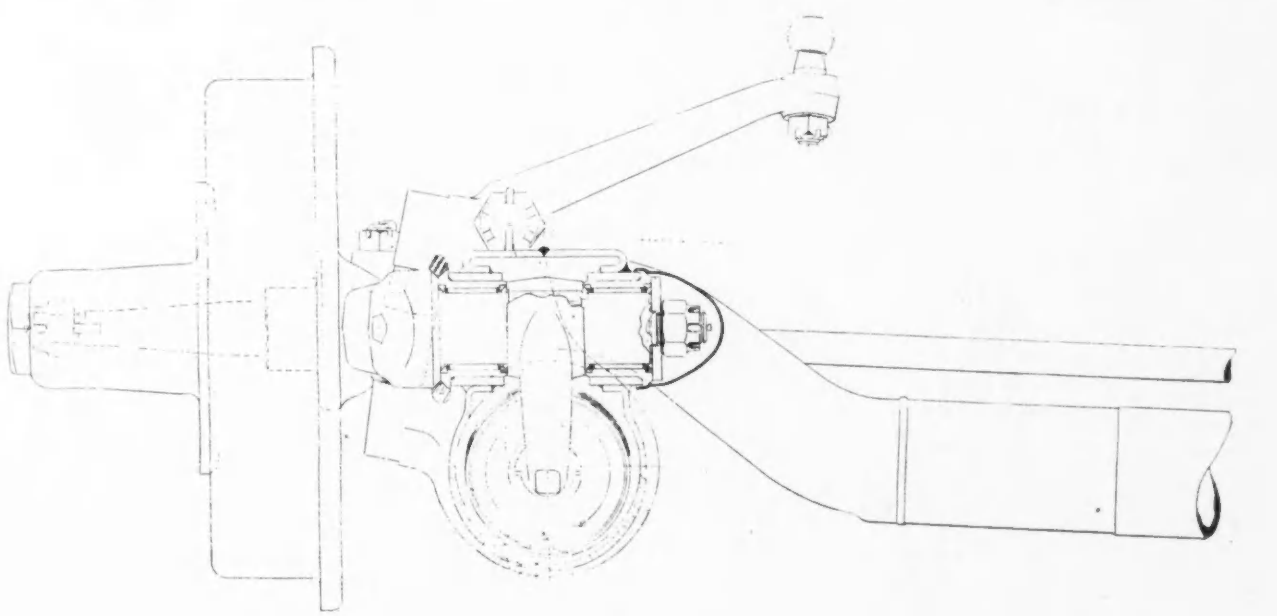
With increasing speeds, greater responsiveness to control is essential. The coincidental starter and the combination of the automatic clutch actuation with the accelerator pedal are meritorious examples. This however leaves the brake pedal actuation the same complicated process whereby the foot must be removed from one pedal to the other. The combination of the braking function with an accelerated pedal has been proposed but would require a most dexterous foot. I believe that a hand control close to the steering wheel rim looms as a future possibility.

A number of the modern cars have a very high reduction ratio in the steering gear which must be corrected to assure satisfactory operation.

Independent wheel suspension of the parallel link type has increased the number of ball joints whose friction negatives the free acting steering gear and the anti-friction mounting of the tie rod lever. With a 300-lb. load on the housing of the rod end, the Ross Gear and Tool Co. found that the least effort required for rocking a joint was 33 in-lb. and the greatest was 175 in-lb. For rotating the ball under the same load a minimum load of 12 in-lb. and a maximum of 66 in-lb. was noted. Several of these joints permitted of excessive lost motion, the movement varying from 0.003 in. to 0.018 in., and on some a "rubbery" feel was in evidence which is generally not regarded as a pleasing feature in a steering linkage. The test results are tabulated in Table 5. Freedom from frequent lubrication is desirable as well as greater efficiency due to the increased steering power requirements with individual wheel suspension. The new Ross rod end is shown in Fig. 19, in which it will be seen that there are a number of ⅛ in. and 3/32 in. steel balls between the large ball and the shell of the rod end. An adjustable spherical headed set-screw projects through the shell whereby initial adjustment is obtained. Once set, it has been proven by test that practically no wear ensues.

Bodies

There is no formula for beauty. The public rebels at too much standardization of appearance. This is a good thing to assure a variety of design which nevertheless must be based on sound fundamentals. What would look well in a large fountain on spacious grounds would not do in a vehicle that symbolizes speed and agility. I pause on the



of Dubonnet Suspension Unit

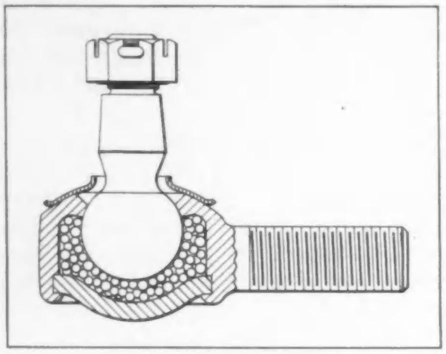


Fig. 19—Ross Ball End

street or road when I see some of the new sheet metal and body notions which are new and different but—! As soon as front ends are pleasant, a crop of ugly rear ends appear. But tastes are infinite and the public buys. Unconsciously the majority do hit it right most of the time and sales make an excellent barometer of the correct design, which, however, is transient in keeping with the public's education.

The streamlined car is at last taking form. It is not a mere reflection of other endeavors in the reduction of air resistance nor should it be blindly conceived from the experiences in other fields. Automobiles require their own peculiar technique. Many do not believe that streamlining is essential, due to the often low speed of travel. To hold its place in the field of transportation in competition with the airplane and the new forms of railroad transportation (which are and will be designed by automotive men), car speeds of 100 to 120 m.p.h. are coming as soon as the much talked of super-highways are built. There is plenty of work ahead for us all. Think what doubling road speed means in the revamping of the entire car!

Rear tires have more than they can do now in propelling the car. A practical four-wheel-drive car is as necessary today as four-wheel brakes were a decade ago. So while one faction argues about the rear engine location and the other about retaining it at the front, some one may reduce the pancake motor to wafer thinness and drive to both axles. Or the two factions might get together and compromise on a power plant at each end unless a new type or scheme of power transmission allows the power plant to be concentrated at one location.

Getting back to the cars of today, it seems a hopeless task at the moment to get air resistance coefficients of different body designs. There has been considerable activity on wind-tunnel tests but as they are all in the hands of industrial organizations and in view of the state of the art, they are not releasable at present.

Furthermore, the air resistance coefficient is subject to so many variables which can vitally affect its numerical value that it is practically impossible to compare the drag coefficient obtained in various laboratories. This coefficient Kx is derived from obtaining real values for the remaining variables in the equation $D = \delta K \times AS^2$, where δ is the density, A the maximum cross-sectional area on the projected area, and V the speed. If the test is made of a model in the wind tunnel, many additional variables will affect the result, such as Reynolds' number, general shape of the model, completeness and form of the details, tunnel constants, method of mounting the model, etc. If this test is made in the full scale on the road, it is subjected to all the experimental errors and the rolling resistance reduction. In addition to the above and regardless of method, the coefficient is subjected to the great variation of using a comparative cross sectional area and making proper allowance for contour under the car. If projected area is taken, an untrue result may be obtained, as due to the large fenders a much greater area may result which is not true as far as the actual area flow is concerned. The above miscellaneous factors represent a few of the difficulties which have been experienced in attempting to compare one laboratory's test results with another or with published data.

Prof. W. E. Lay's extraordinary paper at the 1933 Annual Meeting is the latest mine of information that I can refer to.

Ventilation is receiving considerable attention and air conditioning is not in the too distant future. Exhausting the air from the rear windows with real fresh air entering the front of the body prevents the entrance of engine fumes that sweep back along the surface of the body.

Insulation from heat and noise has made rapid strides. The new material, Seapak, after demonstrating its ability in airplane cabins was quickly adopted. For heat insulation, a figure of $k = 0.246$ can be used for its conductivity factor. Appendix C summarizes its ability as a noise insulator.

The modernistic furniture trend of car seating and greater widths at the front promote comfort. The next step is that all seats but the driver's be loose so as to be placed where desired. The public likes to play bridge and sit around a table.

Table 5—Tie-Rod-End Efficiency

Ross Ball Joint				Production Joint No. 1			No. 2			No. 3			No. 4			No. 5			No. 6			No. 7		
Load on Housing, Lb.	Effort-Rocking, In-Lb.	Effort Rotating, In-Lb.	Drop of Housing, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.	Rocking, In-Lb.	Rotating, In-Lb.	Drop, In.
0	0	0	0	5	0	0	1½	3	0	18	22	0	4½	9	0	15	4½	0	36	9	0	108	36	0
50	6	6	0	6	2	.001	10½	10½	.003	..	..	0	9	16½	0	21	13½	0	36	10½	.001	117	36	.002
100	12	12	.001	12	5	.008	10½	16½	.003	..	..	0	12	22½	.001	30	28½	.0025	36	15	.0025	130	36	.003
150	20	20	.0015	18	6	.012	15	22½	.004	..	..	.005	18	25½	.001	45	36	.005	42	19½	.004	140	37⅛	.004
200	23	23	.002	24	7	.014	21	27	.0045	..	..	.015	27	39	.001	63	45	.006	65	24	.0055	142	40½	.005
300	34	34	.003	44	12½	.018	33	33	.0055	..	..	.075	36	48	.002	84	66	.009	74	35	.0105	175	42¾	.006

Servicing

The one end of the automobile field that requires thought and revamping is the service end. The cost is excessive when compared to manufacturing the product. Should cars be designed so that everything can be changed or adjusted or should we make the units non-adjustable? The Ford is to a large extent and the recently published replacement costs of entire units or small assemblies is a revelation when compared with the usual overhaul in the service station.

Engineering in service as exemplified by the work of Cities Service is most commendable. The use of the exhaust gas analyzer is extending. The method of draining the crankcase sump by removing the age-old plug is being replaced by a suction and return pumping apparatus with a glass inspection tank.

The new designs have in many cases made the chassis lubricating fittings more inaccessible. This began with greater covering of the chassis by the sheet metal. The new individually sprung front ends have called for new types of service station lifts. There was a case where a car fell from the lift even though the special attachment designed to prevent this was used.

Engineer Vs. Management

At the recent S.A.E. Tractor and Industrial Power Equipment Meeting, Fowler McCormick of the International Harvester Co. defined the engineer's duty as follows: "To be able to design the best product for each purpose regardless of how much such a product would cost to produce." How many instances there are where the sales department and the management get together and decide they want a little roomier body, a few inches more wheelbase, that the tire and wheel size should be changed because some one else is doing it!

The car should be designed and based on a critical study by the engineers and the management before its adoption by the latter. Sometimes the production line is started by the time the model car is ready to go on the road and the rest of the time is spent overcoming troubles in production that should have been taken care of on the model car. I trust that the title of my paper will reach the ears of the few who might give the engineers more chance.

In conclusion I trust that I have shown that out of the complexity of the modern automobile, a little change for the better here and there will collectively amount to a great deal in the performance and that every gain, no matter how little, is well worth while.

Appendix A

Description of Methods in Obtaining Buick 33-90 Curves, in Fig. 1

1. The indicated horsepower was obtained by adding the motoring friction horsepower to the corrected brake horsepower. All data were corrected to the General Motors correction factor for 103 deg. fahr.

2. The brake horsepower curve without muffler or fan was an actual power test of the production Series 8-90 engine. The test was run from 300 to 3600 r.p.m., inclusive and the data above 3600 r.p.m. were obtained by extrapolating the torque curves and calculating the brake horsepower from the curves.

3. The brake horsepower curve with muffler was an actual power test made with the engine as above, with a 1933 production resonance muffler.

4. The brake horsepower curve with muffler and fan was obtained by determining the horsepower required to drive the fan and using 60 per cent of this value and subtracting it from the horsepower with the muffler. The value 60 per cent was agreed upon as approximating the power required to drive the fan in the car.

5. The loss through a production transmission was found to be a constant torque loss of 4 ft-lb., and this was subtracted from curve No. 4 to show the remaining available power.

6. The rear axle efficiency was taken as 98 per cent as shown in Report—. This curve No. 6 is 98 per cent of curve No. 5.

7. The tire loss was taken from a report furnished by the United States Tire Co., using their recommendation of 80 per cent of the values shown in the data. These losses were subtracted from curve No. 6 to obtain curve No. 7.

8. The wind resistance was calculated using General Motors Test Code formula as follows: $0.0018A \times (V^3/375)$ except changing the value 0.0018 to 0.0017. The data were subtracted from curve No. 7 and show the speed of the car at the point the horsepower curve intercepts the abscissa. The area between the abscissa and the horsepower curve is the power available for acceleration.

Appendix B

Tests With Hypoid Gears

The spiral bevels were mounted in the manufacturer's present production axle and the hypoids in an experimental axle made by the same manufacturer along very similar lines. The hypoid axle weighed slightly less than the spiral job. The hypoid gears had a fatigue life almost twenty times greater than that of the spiral bevels. The conditions under which the two types of axles were tested and the results obtained are given in the following table:

	Spiral Gears	Hypoid Gears
Outside Diameter of Gear—in.	9½	9½
Length of Face of Gear—in.	1⅜	1⅜
Combination	10 × 41	10 × 43
Offset (of hypoid)—in.	———	1¾
Weight of complete carrier assembly—lb.	75½	73
Pinion Torque Applied—in-lb.	6,713	6,713
Torque on Axle Shafts—in-lb.	27,524	28,867
Total Tooth Load—lb.	5,790	6,040
Tooth Load per 1 in. Face—lb.	4,210	4,390
Number of cycles of pinion to failure of the axle	143,336	2,246,404
Type of failure	Pinion Fatigue Fracture	Pinion Fatigue Fracture

The load applied was equivalent to maximum motor torque through low gear. The conditions of test were kept identically the same for both types of axles. There was no appreciable wear of the gears in either type of axle.

A running test was recently made to compare the load-carrying capacity and smoothness of operation of conventional cut, hardened and lapped hypoid gears and ground gears. All gears were tested in the same axles, under identically the same conditions. Comparison of the two types of gears was based on the appearance of the tooth bearing surfaces after the test.

The conclusion was drawn that the ground gears, run under a torque load 20 per cent greater than that imposed on

the conventional gears, showed a definite improvement in the condition of the bearing surface of roughly 20 per cent over that of the cut and lapped gears.

The ground gears were definitely quieter in operation.

By grinding the teeth of gears better precision is possible, enabling the manufacturer to decrease backlash, secure a better tooth bearing, and improve the operation of the gears in service.

The greater area available for bearing surface due to the absence of cutter marks and surface irregularities tends to decrease the unit pressure, thus decreasing the wear and increasing the load-carrying capacity.

Appendix C

Sound Tests With Seapak

Experimental Setup.—The metal dash of a car was mounted in a window placed in a wall between two rooms. The wall was of 3 in. concrete, and the mounting was such that there was no passage of sound from room to room except by way of the dash. All openings and screw holes in the dash were sealed. The source of sound was placed in a heavily insulated box in one room, and the sound pick-up in a similar box on the opposite side of the dash in the other room. The source of sound was kept constant, and the reduction of sound intensity produced by the application of pads to the dash over that produced by the bare dash was measured. Tests were made at 60 cycles. The results are shown in the following table:

Material	Reduction in Decibels	Weight Oz.	Thickness Exclusive of Cardboard, In.
Seapak W	2.7	24	1/4
Seapak X	5.7	29	3/8
Seapak Y	9.0	36	1/2
Seapak Z	10.1	42	5/8
Jutefelt A	2.1	36	5/8
Jutefelt B	2.8	57	1
Jutefelt C	2.4	50	3.4
Jutefelt D	8.0	66	1 3/16

(Sample D has ½-in. fibre board in addition to Jutefelt)

These results indicate that the dash pads are effective to the degree shown at the low frequency of 60 cycles. Experiments showed that the fundamental frequency of the dash without a pad was between 70 and 80 cycles, so that a driving frequency of 60 cycles is below the natural frequency of the dash panel. Under this condition the pad supplies a certain amount of damping of the vibration. Further, the tests show that the Seapak is decidedly superior to the Jutefelt pads of even greater weight.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between June 10, 1934, and July 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

EVANS, EDWARD S., JR. (A) vice-president, Evans Appliance Co., 253 Vinewood, Detroit; (mail) 1005 Three Mile Drive, Grosse Pointe, Mich.

FLETCHER, JAMES (M) paint experimental engineer, Hudson Motor Car Co., 12601 East Jefferson, Detroit; (mail) 17419 Kentucky Avenue.

FROMM, HARRY E. (M) sales manager, Chrysler Motors, Amplex Division, Detroit; (mail) 7900 Jos. Campau Avenue.

GILBERT, LEONARD BECK (A) national account salesman, White Co., 2401 Archer Avenue, Chicago; (mail) 1304 Birchwood Avenue.

GODDARD, PAUL B. (A) works manager, Universal Products Co., Inc., 6455 Kingsley Avenue, Dearborn, Mich.

INTEMANN, HERMANN KOLLE (M) engineer, Halowax Corp., 247 Park Avenue, New York City.

MURPHY, HOWARD F. (J) mechanical engineer, Schwitzer-Cummins Co., Indianapolis; (mail) Massachusetts Avenue at Fan Street.

NEVIN, THOMAS MARSHALL (M) test engineer, Pierce-Arrow Motor Car Co., Buffalo, N. Y.; (mail) 154 West Utica Street.

NORRIS, R. F. (M) research engineer, C. F. Burgess Laboratories, Inc., Madison, Wis.; (mail) 1011 East Washington Avenue.

SANDERS, ROBERT (J) engineer, Pan American Grace Airways, Inc., Lima, Peru, South America.

WOLFE, ARTHUR D. (J) vice-president, general manager, Motor Valve Products Corp., 310 North Walnut Street, Ravenna, Ohio; (mail) 314 East Main Street.

Applications Received

The applications for membership received between June 15, 1934, and July 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

BEST, FRANK ADAM, manager, Backstay Welt Co. of Canada Ltd., Windsor, Ont., Canada.

CALKINS, LOUIS A., chief chemist, Valvoline Oil Co., Cincinnati, Ohio.

CAMPBELL, KENNETH, test engineer, Wright Aeronautical Corp., Paterson, N. J.

CAMPBELL, WALLACE R., president and treasurer, Ford Motor Co. of Canada Ltd., E. Windsor, Ont., Canada.

FAWVER, J. C., chemist, plant superintendent, Panther Oil & Grease Mfg. Co., Fort Worth, Texas.

HARWOOD, CHANNING E., manager, research, The Russell Mfg. Co., Middletown, Conn.

HASKELL, RAYMOND, industrial engineer, The Texas Co., New York City.

JACKSON, RICHARD W., experimental engineer, Hudson Motor Car Co., Detroit.

KENNEDY, HARVEY T., physical chemist, Gulf Research & Development Corp., Pittsburgh, Pa.

LANE, JOHN WOODBURY, automotive engineer, Standard Oil Co. of New York, Boston.

PERRILL, HARLAN KNOX, Lieutenant, U. S. Navy, R.O.T.C., University of Michigan, Ann Arbor, Mich.

RADOW, HIMAN, 301 Third Ave. S., South St. Paul, Minn.

WILDER, AUSTIN B., automotive engineer, Pure Oil Co., Chicago.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Aircraft Performance Testing

By S. Scott Hall and T. H. England. Published by Pitman Publishing Corp., New York, 1933; 206 pp., illustrated. [A-1]

While written primarily for the constructor who wishes to put his aircraft through an adequate program of tests on modern lines, the book should prove useful to test pilots and to all engaged in performance work, and should provide a comprehensive survey of the subject for the student. A knowledge of elementary aerodynamics is assumed but the book is arranged so that the test pilot is able to see readily in what manner any particular test should be carried out and what information he should obtain, without the necessity of studying either the method or the subsequent reduction, nor the theory underlying it.

The book treats of weighing, loading, centre of gravity determination, and airscrew calibration; test instruments; performance tests covering position error determination and measurement of R.P.M. to fly level, partial climbs, determination of best climbing speed, full climb and level speed; take-off and landing tests; measurement of stalling speed and partial glides; tests on fuel consumption, oil temperature, radiator suitability, handling, longitudinal stability, spinning and diving; trials for certificate of airworthiness; theory of performance reduction and performance analysis.

Relations entre les Performances d'un Avion

By R. Salle. Published in *L'Aéronautique*, June, 1934, L'Aérotechnique section, p. 53. [A-1]

A series of equations are developed for the determination of performance characteristics of an airplane from given design features and examples worked out for 3 French airplane models.

The Aircraft Year Book for 1934

Published by the Aeronautical Chamber of Commerce of America, New York, 1934; 501 pp., illustrated. [A-3]

Volume Sixteen of the Aircraft Year Book, an indispensable tool to the aircraft industry, is now available.

Instrument Flying

By Howard C. Stark. Distributed by James Stark, Pawling, N. Y., 1934; 77 pp., illustrated. [A-4]

The author sets forth a single instrument arrangement and a specific location for the panel in an attempt to arrive at a standard arrangement that will satisfy all of the requirements of blind flight. Considerable space is devoted to the use of the rate instruments and general instructions given on the amount instruments.

Mr. Stark will be remembered as author of *Blind or Instrument Flying*. His long experience as a pilot under conditions requiring blind or instrument flying form the background for his books.

ENGINES

Further Investigations Into Oil-Engine Injection Systems

By S. J. Davies and E. Giffen. Published in the *I.A.E. Journal*, June-July, 1934; p. 8. [E-1]

This paper is a continuation of a previous paper by the same authors which appeared in the April, 1923, issue of the *I.A.E. Journal*. The methods and apparatus used in the experimental work described in the earlier paper were utilized in certain of the experiments covered in the present paper. Tests, made on further variables of a fuel injection system with open nozzles, are described, the particular points investigated being: (a) the effects of different physical properties of the fuels. (b) of different diameters of piping, (c) of an additional local capacity in the pipe, and (d) of different cross-sectional areas of the nozzles. Important differences introduced by the use of spring-loaded nozzle are discussed and data from further experiments are presented bearing on these matters.

What Members Are Doing

John M. Orr, general manager, Equitable Auto Co.; *B. H. Eaton,* motor vehicle superintendent, Bell Telephone Co. of Pa.; and *Frank E. Taws,* manager, automobile department, H. J. Heinz Co. have been appointed members of the Automotive Subcommittee of the Engineering Committee of the Efficiency and Economy Commission of Pittsburgh. The work of this subcommittee involves study of applications of automotive vehicles and of maintenance methods. Recommendations will be made looking to greater economy and efficiency in such operations.

The executive offices of the *Aeronautical Chamber of Commerce of America, Inc.,* have been moved from New York to the Shoreham Building, 15th & H Sts., Washington, D. C. A small office and library have been retained in Room 2026 in the R.C.A. Building at 30 Rockefeller Plaza, New York.

C. E. Harwood has been named sales manager, automotive equipment division, Russell Manufacturing Co. He has been connected with the Russell organization since 1915, except for two years spent in overseas service during the World War.

C. E. Harwood

Roy S. Sanford, who is now consulting engineer for Bendix Aviation Corp., Bendix Westinghouse Automotive Air Brake Co. and Dunbar-Gibson, Inc., has moved his office to 267 Fifth Ave., New York City.

Stephen J. Zand, Sperry Gyroscope Co., who sailed for Europe early in July, is expected to return to this country some time after the middle of September.

W. Dean Burton is in the astrophysical laboratory of the California Institute of Technology at Pasadena.

Charles H. Dolan, former vice-president in charge of operations for Eastern Air Transport, Inc., has moved to Coral Gables, Fla., where his address is P. O. Box 573.

George N. Hickey is district sales manager in New York for the Buda Co. He was formerly general manager of the motor division of the Gifford Wood Co., Hudson, N. Y.

R. A. Weinhardt has been appointed assistant chief engineer of the passenger-car and truck divisions of the Reo Motor Car Co., Lansing, Mich. Since 1924, Mr. Weinhardt had been on the engineering staff of the Packard Motor Car Co., recently as chassis engineer. Just previous to joining Reo, he was with the Auburn Automobile Co. as design engineer.

R. A. Weinhardt

Best known as an engine designer, Mr. Weinhardt was concerned with the development of the Packard engines for Gar Wood's speedboats, used in the Harmsworth Trophy races and in setting world's speed records for boats. He has been a member of the Society since 1924.

L. P. Croset has joined Blackstone & Co., Ltd., Stamford, England, as engineer-designer. He was formerly connected with Scintilla, Ltd., Soleure, Switzerland.

Lars J. Istad has joined the Lawrence Engineering and Research Corp., Linden, N. J. He was formerly with the Wichman-Motor-fabrik, Sunnhordland, Norway.

James J. Welker has been named director of service for General Motors-Holden's, Ltd., South Melbourne, Victoria, Australia. He has been parts manager for the same organization.

Fredrick W. Stein has been named factory superintendent of the Standard Register Co., Dayton, Ohio. He was connected with Fairbanks, Morse & Co., Beloit, Wis.

J. P. Ripley has been elected president of Brown Harriman & Co., Inc., New York City. He was formerly a vice-president of the City Company of New York, Inc.

F. Vernon Bistrom of the Isaacson Iron Works, Seattle, Wash., is now truck-equipment engineer for the company.

Gustave Sparre is aeronautical engineer and designer with the Kellett Autogiro Corp., Philadelphia. He was formerly with the Waco Aircraft Co. as engineer-draftsman.

Norman A. Best has been appointed machine-shop superintendent for the Dow Chemical Co., Midland, Mich. For the past year he has been mid-continent division manager for Dowell, Inc., a subsidiary of the Dow Chemical Co., and has been stationed at Tulsa, Okla.

Jay Willard Lord has joined the motor-transport department of the Atlantic Refining Co., Philadelphia. Formerly he was a parts and service representative with the Buick-Olds-Pontiac Sales Co., in New York.

Charles W. Fairbank, former assistant to the superintendent of motor vehicles, Standard Oil Co. of N. J., has been named maintenance superintendent for the Colonial Beacon Oil Co. New York City.

Walter R. Lindsay, former technical assistant with the Ford Motor Co., Ltd., Essex, England, has been transferred to the Henry Ford & Son, Ltd., plant at Cork, Ireland, as technical assistant in the service department.

John P. Hobart has left the employ of the Auburn Automobile Co., Auburn, Ind., and has joined the Allen Electric & Equipment Co., Kalamazoo, Mich.

Maurice Reswick has joined the Standard Oil Co. of N. J. in New York City. He was formerly chief engineer of the Pennsylvania Lubricating Co., Pittsburgh, Pa.

Chris J. Fields is with the Murray Corp. of America as body full-size layout man. He was recently with the Hercules Body Co., Evansville, Ind., in the same position.

Walter S. Peper, chairman of the Metropolitan Section during the 1933-34 season, has joined the Gulf Refining Co. His position will be automotive engineer and his headquarters will be in New York City. Until recently, Mr. Peper was sales engineer for Wheels, Inc., in New York.

Charles L. Tutt, Jr., is enrolled in the college graduates' training course conducted by the Buick Motor Car Co.

William Hastings Bassett

William Hastings Bassett, metallurgical manager, American Brass Co., and chairman of the Non-Ferrous Metals Division of the S.A.E. Standards Committee, died July 21 of an embolism.

Mr. Bassett, a pioneer in the non-ferrous metal industry, was president-elect of the American Society for Testing Materials. He had served as president of the American Institute of Mining and Metallurgical Engineers and as a director of the American Institute of Chemical Engineers. He joined the American Brass Co. in 1903, after having been connected with the Popes Island Mfg. Co., the Newark Works of the New Jersey Zinc Co., and the Coe Brass Mfg. Co. During the World War he was a member of the Committee on Materials for Airplane Construction in Washington.

Mr. Bassett joined the S.A.E. in 1917. His memberships in other technical societies and clubs were numerous, both in the United States and in England.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between July 10, 1934, and Aug. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ANDERSON, DAVID R. (A) manager, automotive division, Berry Bros., Inc., 211 Lieb Street, Detroit; (mail) 3954 Gray Avenue.

BAKER, DWIGHT S. (M) research engineer, Hyvis Oils, Inc., of California, 434 Commercial Street, Los Angeles.

BAMPTON, CYRIL CHARLES (M) chief transport superintendent, Iraq Petroleum Co., Ltd., Haifa, Palestine.

BEARDSLEY, RAYMOND R. (A) assistant sales manager, Sealed Power Corp., Muskegon, Mich.

BRAMHALL, LESLIE E. (A) assistant foreman, State of California, Department of Public Works, Equipment Department, Bishop, Calif.; (mail) 705 West Pine Street.

CARR, GEROME BYRON (M) automotive superintendent, Wilshire Oil Co., Inc., 2455 East 27th Street, Los Angeles.

CLAUSEN, CHRISTIAN E. (J) mechanical engineer, Fairbanks, Morse & Co., Beloit, Wis.; (mail) 936 Ninth Street.

CYPHERS, W. D. (A) assistant general manager of sales, Marathon Oil Co., Thompson Building, Box 981, Tulsa, Okla.

DAHLMAN, GUSTAVE R. (J) engineer, Skinner Chuck Co., New Britain, Conn.

DEVITT, NORMAN WRIGHT (A) president, general manager, National Automotive Parts, Ltd., 865 Bay Street, Toronto, Ontario, Can.

EASTERN MASSACHUSETTS STREET RAILWAY Co. (Aff.) 38 Chauncy Street, Boston; Representatives: Boardman, A. J.; Bolt, Walter C., Chelsea, Mass.; Howard, Fred B., Brockton, Mass.; Hurlock, Horace T., Chelsea, Mass.; Sullivan, H. I., Quincy, Mass.

ENSIGN, R. O. (A) parts and service manager, American Austin Car Co., Inc., Butler, Pa.; (mail) 250 Merton Road, Detroit.

ESPOSITO, PATRICK A. (A) partner, manager, Coastwise Auto Repair Co., 284 Van Brunt Street, Brooklyn, N.Y.

ESTABROOKE, JOHN C. (J) student, New York University, New York City; (mail) 10 Prospect Drive, Yonkers, N. Y.

GARDNER, ALLEN F. (A) sales engineer, Chicago Rawhide Mfg. Co., 9000 Alpine, Detroit.

HAMILTON, DANIEL E. (A) automotive and aircraft service engineer, Ethyl Gasoline Corp., Chrysler Building, New York City; (mail) Colonial Inn, 15th and Quaker Streets, Tulsa, Okla.

HARTNETT, LAURENCE JOHN (FM) managing director, General-Motors-Holdens, Ltd., Melbourne, Australia.

HUBBARD, JOHN R. (SM) Captain, U. S. Army, Quartermaster Corps., War Department, Washington, D. C.; (mail) 4000 Cathedral Avenue, North West.

HUGHES, JACK (A) fleet service instructor, Chevrolet Motor Co., Detroit; (mail) 3221 Commerce Street, Dallas, Texas.

HUNT, ROBERT (M) assistant general superintendent, motive power, Seaboard Air Line Railway, Norfolk, Va.

LEE, HERBERT (FM) service engineer, Light Production Co., Ltd., 60166 Rochester Row, London, S. W. 1, England; (mail) 482 Hagley Road West, Quinton, Birmingham, England.

LONG, LEIGHTON M. (M) metallurgist, Bunting Brass & Bronze Co., Toledo, O.; (mail) 220 Dale Street.

LYON, RALPH P. (A) special agent, Standard Oil Co. of California, San Francisco; (mail) 622 North Douty Street, Hanford, Calif.

McDUFF, AMOS J. (A) New England manager, D. A. Stuart & Co., Chicago; (mail) 943 Boylston Street, Newton Highlands, Mass.

MYERS, RAYMOND (A) service manager, Lafayette Motor Sales, Inc., Suffern, N. Y.; (mail) Darlington Road, Ramsey, N. J.

PAMPLIN, DOUGLASS G., 1st Lieut. (SM) U. S. Army, Coast Artillery Corps, Quarters 10, Fort McClellan, Anniston, Ala.

RITTER, W. K. (J) junior mechanical engineer, National Advisory Committee for Aeronautics, Hampton, Va.; (mail) 3209 Chesapeake Avenue.

RODGERS, GEORGE C. (J) test engineer, Wright Aeronautical Corp., Paterson, N. J.; (mail) Room 514, 128 Ward Street.

ROSSNER, EMERY (M) designer, International Motor Co., 10th and Harrison Street, Allentown, Pa.; (mail) Post Office Box 565.

STANDARD MOTOR PRODUCTS, INC. (Aff.) 1025-46th Avenue, Long Island City, N. Y. Representative: Kameny, Emil.

STOECKEL, ROBBINS B. (M) research associate in highway transportation, Yale University, Strathmore Hall, New Haven, Conn.

TAYLOR, HERMAN W. (A) manager, lubrication sales, General Petroleum Corp. of California, 108 West Second Street, Los Angeles.

VINTSCHGER, FRANCIS E. (J) student, Casey Jones School of Aeronautics, Newark, N. J.; (mail) Normandy Boulevard, East Morristown, N. J.

WILBER, G. R. (A) president, Blood Brothers Machine Co., 1 Glass Street, Allegan, Mich.

WRENN, JOHN JOSEPH (J) sales engineer, Autocar Co., 553 West 23rd Street, New York City.

Applications Received

The applications for membership received between July 15, 1934, and Aug. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ARMSTRONG, WERNER E., research engineer, Briggs and Stratton Corp., Milwaukee, Wis.

ASKREN, RICHARD W., supervisor, U. S. Tire Co., Inc., Indianapolis, Ind.

BASHAM, DOUGLAS H., service mgr., Philadelphia Auburn Cord Co., Philadelphia, Pa.

BOCK, EUGENE, manager, North Shore Auto Parts Co., Inc., Flushing N. Y.

BRANER, S. W., sales engineer, Victor Mfg. & Gasket Co., Chicago, Ill.

CLARK, FRANKLIN D., sales engineer, Bantam Ball Bearing Co., South Bend, Ind.

COLE, CARTER S., engineering assistant, Copper & Brass Research Assn., New York City.

COVERT, M. B., president, Renu Parts Corp., Holland, Mich.

DASKAL, GEORGE H., secretary, Perfection Gear Co., Harvey, Ill.

DEWAR, ARTHUR G., draftsman, Murray Corp. of America, Detroit, Mich.

GIFFORD, WEARMAN MARSTON, general sales manager, Aluminum Co. of Canada, Ltd., Toronto, Ont., Canada.

HUTCHINSON, ROBERT HALLER, chief engineer, DeHavilland Aircraft Co., Middlesex, England.

LAPPIN, ARTHUR NORMAN, engineer, Amphibions, Inc., Garden City, N. Y.

MALONEY, JOHN SCOTT, draftsman, Rolls-Royce of America, Inc., Springfield, Mass.

MURRAY, H. AUSTIN, automotive engineer, The Texas Co., Boston, Mass.

RAJESINGHAM, CHELLIAH, examiner of motor cars, Office of the Registrar of Motor Cars, Colombo, Ceylon.

RICHARDSON, DALLAS G., salesman, Hastings Mfg. Co., Portland, Ore.

RUSSELL, FREDERICK C., owner, The Russell Service, West Hartford, Conn.

SEYFFARDT, ALFRED LODEWIJK WITTEM, Lieutenant, Royal Army Motor Traction, Haarlem, Holland.

SONKIN, JESSE, office and advertising manager, Mott Haven Truck Parts, Inc., New York City.

ULMANN, ALEXANDER EDWARD, export sales manager, Multibestos Co., Cambridge, Mass.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members. Orders should specify the name of the author as well as the title of the paper desired.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Allen, H. H., Rodgers, G. C. and Brooks, D. B.
Ice Formation in Aircraft Engine Carburetors

Barish, Thomas
Bearings for Controllable Propellers

Barnard, D. P.
Butane Vs. Gasoline As an Automotive Fuel

Becker, A. E. and Fischer, H. G. M.
An Index of Diesel Fuel Performance

Bleicher, C. E.
External Broaching

Bleicher, C. E.
Relative Merits of Precision Manufacturing and Correct Plant Layout to Accomplish Cost, Quality and Uniformity of Parts Production

Brettell, Clinton
How Economies in Motor Vehicle Operation Can Be Effected from an Operator's Standpoint

Briggs, Commander W., and Fox, M. L.
Body Noise

Brown, Lowell H., and Herbert Chase
Streamlining—Up-to-date Facts and Developments

Brown, W. C., and Roper, V. J.
The Well-Lighted Car

Bull, A. W.
Tire Noise

Cass, Robert
Future Trends in Motor Truck Transportation

Chandler, F. F.
Notes on Steering

DeSmet, E. C.
Planography—The New Science of Surface Design

Dillstrom, Torbjorn
A High-Power Spark Ignition Injection Engine

Drake, H. W.
Problems of the Fleet Operator

Fisher, J. B.
Combustion Problems on Automotive Diesel Engines

Fitzsimmons, J. T.
Problems and Tendencies in Electrical Equipment

Foley, Hamilton
The Manufacture and Magnetic Testing of Hollow Steel Propellers

Foster, A. L.
Prospects for Future Diesel Fuels, and Their Available Supply

Froesch, Charles
Some Aspects of Commercial Aviation

Frye, Jack
Aircraft Maintenance on Scheduled Service

Frye, Jack
New Airline Advancements: Maintenance and Operations

Geschelin, J.
Trends and Future Developments in Motor Truck Design

Guernsey, C. O.
Trends in the Design and Application of Motor Trains

Haarz, W. G., Jr.
Beauty Sells Cars in 1934

Havill, C. H.
Theory and Characteristics of Eclipse Automatic Variable Pitch Propeller

Hazard, S., Jr.
Sound Absorption and Deadening

Horner, F. C.
Looking Forward in the Field of Transportation

Howard, H. H.
Some Diesel Tractor Problems

Hunsaker, J. C.
Airships for Commercial Purposes

Jacoby, E. R.
Practical Design Consideration of the Internal Combustion Engine Structure

Jacoby, E. R.
Spark Ignition Engines for Agricultural and Industrial Use

Johnson, W. M.
A Résumé—and Some Conclusions about Automotive Electrical Equipment

Kalb, L. P.
Engine Types Adapted to Automobile Design Trends

Kemper, Carlton
The Design of Fins and Cylinder Baffles for Air-Cooled Engines

Kuttner, Julius, and Rippere, J. B.
Ignition Delay of Diesel Fuels Measured by Bouncing Pin in C.F.R. Engine

Lampton, G. T.
The Design Requirements of a Mechanical Controllable Propeller

Lansing, R. P.
Starters for Diesel Engines

Larson, C. M.
Lubrication of Engines with Different Bearing Metals, with Special Reference to Copper Lead Alloys

McCormick, Fowler
The Relation of Engineering to Manufacturing and Distribution in the Farm Implement Industry

Macauley, J. B.
Fuel Economy from the Engine Designer's Point of View

Marvin, C. F., Jr.
Observations of Flame in an Engine

McCrory, S. H.
Research in Agricultural Engineering

Mock, F. C.
Utilization of Heavy Fuel With Spark Ignition

Norris, R. F.
The Automobile Motor Considered as a Sound Source

Northup, A. E.
Future Streamlining

Nutt. Arthur
Correlation of Knock-Rating of Aviation Gasolines

Orr, J. M.
Accident Control in Fleet Operation

Orr, J. M.
Predetermined Operating Requirements for Purchasing Equipment

Peterson, C. D.
Multi-Range Transmissions

Prescott. F. L.
High-Output Poppet-Valve Cylinders

(Continued on next page)

1934 Fuel Detonating Tests

(Concluded from page 17)

standard procedure; and third, to ascertain whether the hill test represented conditions more or less severe than those encountered in actual service.

To the first mentioned reason, for instance, is attributable the ruling that all ratings for any one fuel in any one car must be within 10 per cent of C-8 of each other to be considered valid. Another innovation was the practice of running certain tests "blind," particularly on the level road, where acceleration is more rapid and readings therefore more difficult to obtain. In such cases the identity of both reference and test fuels was concealed so that the observer would not unconsciously be prejudiced in advance by his knowledge of the reference fuels' characteristic behavior.

Another project in the interest of greater accuracy, was an investigation of the effect of changes in the type of reference fuel on road-knock ratings. Two fuel elements were of particular interest, volatility and the characteristics of benzol. Two sets of special reference fuel were included in this investigation: first, blends of low antiknock reference fuel A-3 with a high antiknock fuel, straight run California gasoline (b-9); and second, blends of low antiknock reference fuel A-3 with a high antiknock fuel composed of equal parts of benzol and reference fuel C-8.

Failure to secure knock under the test conditions constituted a problem calling for solution. Two expedients were tried to obtain ratings when this occurred. First, the spark was advanced beyond the basic factory spark setting, but in all cases maintained within reasonable and practical limits of the spark advance for maximum power. In the cases of alterations in the spark setting, specific notation was made on the log sheets of the run. A second method was to blend the non-knocking fuel with a low-octane gasoline and to obtain a rating for the blend. Such blends will also be tested by the C.F.R. Motor Method for the purpose of securing correlation with laboratory results. At least three blends of the fuels were used, one of which was the blend containing the greatest percentage of the high antiknock fuel that could be rated in the car. The percentage of the high-octane gasoline was never less than 60. A curve was then plotted showing the knock rating vs. composition, and the curve extrapolated to indicate the approximate rating of the high-antiknock fuel. However, even when both of these alterations in procedure were tried, certain cars could not be made to knock under any conditions. The rule requiring a rating to be made for every fuel with every car was therefore altered to a requirement for such rating with at least 15 cars.

To check the severity of the hill test and to carry out the provisions of the program for acceleration tests on level road and at high speed, two additional types of procedure were worked out. For the level road ratings, which were thought to represent milder conditions than those of the hill test, a convenient course was laid out. The starting point was to be passed at 10 m.p.h., the speed being adjusted by means of the throttle and not the brake. The throttle was then to be rapidly and smoothly depressed to the full-open position, and, as the speed of the car increased, the following noted: (a) speed at which detonation starts, maximum intensity of knock, (b) speed at which such maximum intensity occurs, and (c) speed at which knock dies out.

Acceleration under full throttle was to be continued until a speed of at least 40 m.p.h. was reached, and, in those cars showing a tendency to knock at high speed, until the knock died out or maximum car speed or safety required the closing of the throttle. In cases where a test fuel would not knock, the reference fuel blend containing the highest per cent of antiknock constituent that would give audible knock was determined and the test fuel reported as better than the reference fuel so found. The unbranded fuels were rated by this method.

Availing itself of the authorization in the program to investigate other procedures, the Test Corps examined the possibilities of the so-called "electric ear," a detonation meter consisting of a condenser type microphone, suspended under the hood, to pick up the knock which was intensified by audio-amplification.

The opinion of the groups charged with investigating this instrument was that, while in the hands of an experienced user it is capable of greater accuracy than the aural method, considerable practice is required before this accuracy is attainable.

At the present writing, the mass of data accumulated during the four weeks of test work is still being tabulated.

The Detonation Subcommittee will render its report after thorough consideration of the experimental findings. The question as to the release and publication of the data will then be in the hands of the C.F.R. Committee.

Papers Available in Mimeographed Form

(Continued from preceding page)

Schwitzer, Louis
The Possibilities of Forced Induction in Automotive Vehicles

Shepard, E. H.
The Economy Fallacy

Smith, C. W.
Comparative Tests of Pneumatic Tires and Steel Wheels on Farm Tractors in Agricultural Operations

Smith, G. W., Jr.
A Technical Education

Staley, A. C.
Requirements of Tractor and Diesel Engines

Stewart, J. P., and Risk, T. H.
Factors Affecting Oil Consumption

Taylor, E. S.
Design Limitations of Aircraft Engines

Thee, W. C.
Standardization of Military Motor Equipment

Tirrell, E. L.
Weight Distribution on Front and Rear Axles of Motor Truck

Treiber, O. D.
Factors in Automotive Diesel Development

Veal, C. B.
Mind or Micrometer

Wheeler, P. R.
Human Engineering

Wilson, R. E., and Barnard, D. P.
Chemical Hay for Mechanical Horses

White, L. T.
Why Waste Fuel Through the Exhaust?

Wolf, A. M.
Lightness in Truck Design

Wright, T. P.
Controllable Pitch Propellers—Design Considerations

Zucrow, M. J.
Some Experiences with Heavy Fuel Equipment for Spark Ignition Engines

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Working Charts for the Determination of Propeller Thrust at Various Air Speeds

By Edwin P. Hartman. N.A.C.A. Report No. 481, 1934; 21 pp., illustrated. Price, 10 cents. [A-1]

Wing-Fuselage Interference, Tail Buffeting, and Air Flow About the Tail of a Low-Wing Monoplane

By James A. White and Manley J. Hood. N.A.C.A. Report No. 482, 1934; 21 pp., illustrated. Price, 10 cents. [A-1]

Analysis of Spinning in a Monoplane Wing by the Induction Method as Compared with the Strip Method

By L. Poggi. Translated from *L'Aerotecnica,* Vol. XIII, No. 10, October, 1933. N.A.C.A. Technical Memorandum No. 747, June, 1934; 36 pp., 7 figs. [A-1]

Impact Buckling of Thin Bars in the Elastic Range Hinged at Both Ends

By Carel Koning and Josef Taub. Translated from *Luftfahrtforschung,* Vol. X, No. 2, July 6, 1933; Verlag von R. Oldenbourg, München, und Berlin. N.A.C.A. Technical Memorandum No. 748, June, 1934; 32 pp., 6 figs. [A-1]

La Deuxième Coupe Deutsch de la Meurthe

By Pierre Léglise. Published in *L'Aéronautique,* July, 1934, p. 151. [A-1]

French participation in the second Coupe Deutsch at Meurthe, held on May 27, is here accorded a full review, under the following headings: general notes and preliminary trials for 1935; incidents during the competition; detailed descriptions of the four Caudron entries, the Comper "Streak" and the two Potez entries; descriptions of the Charlestop retractable landing gear and the Ratier and Levasseur variable pitch propellers.

CHASSIS PARTS

Etude des Variations de Vitesse du Différentiel dans les Essieux Dits à Demi-Essieux Oscillants

By Grègoire. Published in *La Technique Automobile et Aérienne,* 2nd quarter, 1934, p. 39. [C-1]

This mathematical study of speed variations in the differentials of divided axles as used in independent wheel suspensions leads to the conclusion that such variations are continual when the shafts deviate however slightly from the horizontal.

EDUCATION

English for Engineers

By S. A. Harbarger. Published by McGraw-Hill Book Co., Inc., New York and London, Third Edition, 1934; 314 pp. [D-3]

The author states as the object of his textbook, to make the study of English definite for the engineering student, and to stimulate his interest in a brief but comprehensive survey of the immediate uses to which English may be put by the engineer. The material of the two previous editions has been carefully appraised for its continued and constant relation to those permanent aspects of English that are demanded in all the activities of the practicing engineer and where necessary to meet the changing conditions and new considerations revisions have been made. The collateral reading for the various chapters is for the most part restricted to discussion published in the last five years.

(Continued on page 30)


WHERE CLEANLINESS
APPROACHES THE ULTIMATE

NOTES AND REVIEWS

Continued

ENGINES

Effect of Viscosity on Fuel Leakage Between Lapped Plungers and Sleeves and on the Discharge From a Pump-Injection System

By A. M. Rothrock and E. T. Marsh. N.A.C.A. Report No. 477, 1934; 17 pp., with tables and charts. Price, 10 cents. [E-1]

Les Locomotives Diesel à Transmission Directe

By G. Delanghe. Published in *Le Génie Civil,* July 7, 1934, p. 13. [E-1]

An account is given of the development by the Deutz company of a Diesel engine so supercharged as to permit of its use in propelling a locomotive in direct drive.

Versuche an einem Verbrennungsmotor mit Veränderlichem Kolbenhub, dem Vollkommen Elastischen Fahrzeugmotor

By Josef Schmitt. Published in *Automobiltechnische Zeitschrift,* July 10, 1934, p. 336. [E-1]

Conclusions drawn from these tests of a single-cylinder variable piston-stroke engine are that such an engine is superior to a throttle-controlled engine from the viewpoint of fuel economy and that its torque is sufficient to permit of dispensing with a speed transmission in its operation of an automotive vehicle. However, difficulties are encountered in the design of a satisfactory stroke regulating device.

Neuerungen im Kolbenbau

By Ernst Mahle. Published in *Automobiltechnische Zeitschrift,* June 25, 1934. [E-1]

In discussing new developments in pistons, the author covers the increased demands made on these parts, and recent improvements in alloys, design and manufacturing methods.

Entwerfen und Berechnen Neuzeitlicher Nutzkraftwagen-Motoren

By Karl Schwaiger. Published by M. Krayn, Berlin. 172 pp.; 125 illustrations. [E-1]

The present volume, 14th in the series entitled Library of Automotive Engineering, deals with the design and calculation of heavy-vehicle engines, with especial reference to automotive Diesels. Assuming that engines for motor-trucks and coaches demand an entirely different technique from that used for passenger-car engines, the author presents this volume as a handbook for the design of such engines. Data gathered from existing treatises are supplemented where necessary by previously unpublished information.

L'Action Chimique dans les Moteurs à Injection d'Eau; Emploi d'Autres Fluides Auxiliaires

By Clerget. Published in *La Technique Automobile et Aérienne,* 2nd quarter, 1934, p. 45. [E-1]

The injection of water or other auxiliary liquids as a method of increasing permissible compression pressures is the subject of this article. The author concentrates on the chemical aspects of the question and on the injection type of engine, referring briefly to previous experimenters and in more detail to the apparatus and results of his own tests.

Diesel Hand Book

By Julius Roshbloom. Published by Diesel Engineering Institute, Jersey City, N. J., 1934; 352 pp., illustrated. [E-3]

This volume, described in the subtitle as a practical book of instruction for engineers and students on modern Diesel engineering, land, marine, locomotive, aircraft, automotive and portable installations, discusses in question and answer form the problems encountered in Diesel service.

HIGHWAYS

Engineering Manual for Traffic Surveys

Prepared under the direction of Sidney J. Williams and Peter J. Stupka, by Burton W. Marsh, Earl J. Reeder and Maxwell N. Halsey. Issued by the Federal Emergency Relief Administration, City of Washington, 1934; 15 sections. [F-1]

This manual covering the method of organizing and conducting each of several important studies of a traffic survey including field and office forms and detailed instructions for their use was developed in connection with the national program of uniform traffic surveys. It treats in detail the procedure, instructions, forms and summary of 14 different, desirable studies of a street traffic survey.

(Continued on page 34)

NOTES AND REVIEWS

Continued

MATERIAL

Motor Fuels and Vapor Lock

By George Granger Brown. Preprint of paper presented at the Thirty-seventh Annual Meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June, 1934. [G-1]

All of the available actual road-test data taken under vapor-locking conditions, on the vapor pressure of fuel in the tank of car required to cause vapor lock, were plotted and compared with the limits recommended by the Section on Vapor Lock of Technical Committee A on Gasoline of the American Society for Testing Materials Committee D-2 on Petroleum Products and Lubricants. Under steady driving conditions tests on 60 cars indicate that only three might be expected to experience difficulty, and that 56 would be free from vapor lock even under the maximum temperature conditions allowed in the recommended limits. Upon idling after hard driving, tests on 56 cars indicate that seven might vapor lock and that 48 would be entirely free from this difficulty. Dr. Brown explains that the recommended limits are not intended to prevent vapor lock entirely, but to be a reasonable compromise for present conditions. They have been found to agree with present commercial practice and are somewhat more conservative at high temperatures. According to the author, if all cars were as good as the best, the vapor pressure limits could be raised about 4 lb. with less vapor lock difficulty than is now experienced on some cars. The recommended limits therefore insure reasonable protection to the user from vapor lock so far as the fuel is concerned.

Significant Vapor Pressure Considerations of the Van Slyke Manometric Method of Gas Analysis

By Martin Shepherd. Published in the *Bureau of Standards Journal of Research*, May, 1934, p. 551. [G-1]

The significance of vapor pressures in relation to the *c correction* of the Van Slyke manometric method of gas analysis is discussed. It is shown that the *c correction* changes with temperature in such a way that the determination of one such correction for a particular apparatus (and procedure) is inadequate. The prescribed Van Slyke technique, the author states, may introduce errors amounting to several tenths of 1 per cent in cases where the accuracy claimed is several hundredths of 1 per cent. Other vapor-pressure considerations are discussed and possible errors pointed out. Two suggestions are offered to correct the difficulty, one of which involves a modification of the apparatus.

Calorimetric Determination of the Heats of Combustion of Ethane, Propane, Normal Butane, and Normal Pentane

By Frederick D. Rossini. Published in the *Bureau of Standards Journal of Research*, June, 1934, p. 735. [G-1]

The investigation reported in this article was undertaken because of the dearth of information concerning these thermochemical constants for which there is pressing need in industry and in the sciences. In concluding the author states that the results confirm the suspected existence of exceedingly large uncertainties in the hitherto existing "best" values for the heats of combustion of these gases.

Motors and Fuel Vapor Pressure

By T. A. Boyd. Preprint of paper presented at the Thirty-seventh Annual Meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June, 1934. [G-1]

The schedule of Reid vapor pressures for automobile gasolines proposed by the Section on Vapor Lock of Technical Committee A of the American Society for Testing Material's Committee D-2 on Petroleum Products and Lubricants as being suitable for use at various maximum atmospheric temperatures is discussed, and exception is taken to it from four viewpoints, as follows: first, of the ambiguity of the terms "maximum atmospheric temperature" which it contains; second, of the limitation of Reid vapor pressure as a measure of vapor locking tendency in that gasolines of the same Reid vapor pressure may give off different volumes of vapor at the temperatures reached by the fuel in service; third, of the belief that at least a portion of the schedule is out of line with current commercial practice; and, fourth, of the fact that, as data are presented to show, many cars now in service will give vapor lock on gasolines conforming to the proposed schedule. An alternative schedule is suggested. It is shown, also, that cars have been and are being improved in respect to freedom from vapor lock, and something of the magnitude of the obstacles which must be overcome in making such improvements is suggested.

(*Continued on page 36*)

NOTES AND REVIEWS

Continued

Aluminum Alloys Up to Date

By C. F. Nagel, Jr., and F. C. Pyne. Published in *Aviation*, July, 1934, p. 212. [G-1]

During the past few years research has developed new alloys and new manufacturing technique for aluminum as applied to aircraft. In a series of three articles, of which this is the first, members of the Technical Staff of the Aluminum Company of America will recount recent progress on these materials. The present article deals with the properties and the fabrication of certain wrought aluminum alloys. The Editor reports that subsequent articles will deal with spot welding and riveting, and also with the casting and forging alloys.

Motorisierung: eine Schicksalsfrage für Deutschland Triebstoff: die Schicksalsfrage der Motorisierung

By Dr. Deiters. Published in *Automobiltechnische Zeitschrift*, June 10, 1934, p. 285. [G-1]

Citing statistics of imports and the small reserve supplies of liquid fuels, this article emphasizes the necessity for a domestic fuel supply as the keystone of German automotive development. The direct utilization of solid fuels, such as coal, charcoal, wood and lignite, of which Germany possesses a surplus, is suggested. Other articles in this issue deal further with producer gas equipment, from the viewpoint of theory, design and experience.

Etat Actuel de la Fabrication des Fontes Malleables

By Léon Guillet. Published in *La Technique Moderne*, June 1, 1934, p. 365. [G-1]

The present article opens a series dealing with malleable iron, a subject deemed important because of recent progress both in production and application. Topics to be dealt with are the composition and constitution of malleable iron, recent improvements in its production and heat treatment and the uses of certain special types.

Propriétes, Raffinage et Emploi, comme Carburants, des Essences de Semi-Carbonisation

By Ch. Berthelot. Published in *Le Génie Civil*, July 21, 1934, p. 56. [G-1]

As a result of his considerations on the subject of the properties, refining and use, as engine fuels, of the products of low-temperature carbonization of coal, the author concludes, among other things, that such fuels should be produced to the extent of 40,000 tons in France and 200,000 tons in Great Britain and that in their refining sulphuric acid must be used as well as inhibitors to reduce the possibility of gum formation in the engine.

La Raffinerie de Pétrole de la Standard Franco-Américaine de Raffinage à Port-Jérôme

By E. Lemaire. Published in *Le Génie Civil*, June 30, 1934, p. 577. [G-5]

The solemnity with which was celebrated the opening of the Franco-American Standard Refining Company's plant at Port-Jerome is said to be justified by the size of the new establishment, the perfection of its construction and of its refining methods, and the originality of its method of purifying lubricating oil by the use of phenol. Detailed descriptions are given of the plant and its equipment.

MISCELLANEOUS

The National Physical Laboratory Report for the Year 1933

Published by His Majesty's Stationery Office for the Department of Scientific and Industrial Research, London, 1934; 264 pp., illustrated. [H-1]

A summary of the research projects completed or in progress at the National Physical Laboratory during the past year.

Considérations sur les Roulements à Billes et à Rouleaux

By Pierre Lepeigneux. Published in *Journal de la Société des Ingénieurs de l'Automobile*, May, 1934, p. 2750. [H-1]

In treating roller bearing usage in automotive vehicles, the author discusses permissible loads, friction coefficients, the choice of the correct size and type and the question of adjustment.

Power, June, 1934 [H-3]

The June issue of *Power* marks its fiftieth anniversary and is devoted to the past, present and future of power generation.

(*Concluded on page 38*)

NOTES AND REVIEWS

Concluded

Traitements Thermiques et Déformations

By André Sourdillon. Published in *Journal de la Société des Ingénieurs de l'Automobile,* April, 1934, p. 2692. [H-5]

The author, director of the laboratories of the Latil automobile company, recounts a systematic study of several years' duration there carried on for the purpose of reducing deformation during heat treatment and subsequent service. The results obtained are briefly summarized as well as the modifications in heat treatment instituted because of these results.

Quelques Aperçus sur les Industries de l'Automobile et de l'Aviation au Japon

By Charles Waseige. Published in *Journal de la Société des Ingénieurs de l'Automobile,* May, 1934, p. 2740. [H-5]

That the automotive and aircraft industries of Japan are small and largely dominated by foreign influence, that this condition is due to the lack of practical experience on the part of Japan in these fields, that Japan is determined to and will throw off such tutelage and develop her own characteristic industries—these are some of the conclusions drawn by the author from his observations in that country.

MOTORBOAT

The Motorboat Manual

By the Staff of "The Motorboat." Published by Temple Press, Ltd., London, 11th Edition, 1934; 297 pp., illustrated. [I-3]

The editor points out that since the previous edition of *The Motorboat Manual* was published, three years ago, there has, perhaps, been more progress in the design and manufacture of marine motors—particularly of high-speed Diesel engines—than during the preceding ten years. As a result, very extensive modifications and additions have been made in this new edition.

Many chapters have been completely rewritten; the remainder have been thoroughly revised with a view to bringing the work up to date and increasing its usefulness.

PASSENGER CAR

La Voiture Automobile Actuelle Vue par l'Usager

By Henri Petit. Published in *Journal de la Société des Ingénieurs de l'Automobile,* April, 1934, p. 2705. [L-1]

In dealing with the present-day automobile as viewed by the user, the author, editor in chief of *La Technique Automobile,* bases his analysis on replies to a questionnaire circulated by this publication. The points covered were the weight, make, nature and extent of service of the vehicle owned, fuels used, vehicle characteristics desired and the relations with the manufacturer.

Einfluss der Reichsautobahnen auf die Gestaltung der Kraftfahrzeuge

By W. Kamm. Published in *Automobiltechnische Zeitschrift,* July 10, 1934, p. 341. [L-1]

What changes must be made in the design of automotive vehicles to enable them to attain the safe, economical high-speed operation made possible by the new German automotive highways, and so to contribute their share in realizing Germany's dream of more adequate, flexible transportation than is afforded by the present railway system? The present analysis of power requirements and chassis parts is intended to answer this question.

Die Motorisierung Deutschlands

By J. Zeitel. Published in *Automobiltechnische Zeitschrift,* June 25, 1934, p. 309 [L-1]

A four-passenger car, with a top speed of 75 m.p.h., a streamlined body and either a front engine with front-wheel drive or a rear engine with rear-wheel drive—this in broad outline is the author's conception of the automobile needed for general use in Germany to bring about the motorization of that country. How such an automobile is to be developed, the limitations on its purchase price and operating cost and its general economic effects are also discussed.

How to Drive a Car

By the Editor of *The Motor.* Published by the Temple Press, Ltd., London, Thirteenth Edition, 1934; 155 pp., illustrated. [L-4]

As the title indicates, this handbook is intended primarily to assist the newcomer to motoring to acquire road sense, together with skill in the handling of a car.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Aug. 10, 1934, and Sept. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

BEDELL, SELWYN LLOYD (A) foreman, Howell Motors, Trentham, New Zealand; (mail) 32 Humber Street, Wellington S. 2, New Zealand.

GROAT, CHESTER A. (A) president, manager, Chester A. Groat Auto Co., 318 South Seventh Street, Seaside, Ore.

HAMER, WILLIAM ROBERTS (A) service manager, General Motors Peninsular, S.A., Fabricay Oficinas, Mallorca 433, Barcelona, Spain.

MATHIS, EMILE ERNEST CHAS. (F M) president, Mathis S.A., 200 Route de Colmar, Strasbourg, France.

NAPIER, CARILL S. (F M) technical director, Cirrus-Hermes Engine Co., Ltd., Westcote, Brough, East Yorkshire, England.

NICHOLSON, ARTHUR BORDEAUX, 1st Lieut. (S M) U. S. Army, Coast Artillery Corps, Fort MacArthur, San Pedro, Calif.

PRATT, FRED (A) regional manager, General Motors Truck Co., Fleet Sales Division, Room 1506, 180 North Michigan Avenue, Chicago.

RICHARDSON, WALTER EDWARD (A) Canadian sales manager, AC Spark Plug Co., Ontario Street, St. Catharines, Ontario, Canada; (mail) 814 York Piper Building, 55 York Street, Toronto, Ontario, Canada.

VIANO, FRED N. (A) vice-president, service manager, Colonial Garage, Inc., 1668 Massachusetts Avenue, Lexington, Mass.

WILLIS, ROBERT OLIVER (J) technical manager, Dunopillo department, Dunlop Tire & Rubber Co., Ltd., 870 Queen Street, East, Toronto, Ontario, Canada.

Applications Received

The applications for membership received between Aug. 15, 1934, and Sept. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

ANDREWS, GEORGE J., lieutenant, Police Department, New York City.

CHAPMAN, WILLIAM H., supervisor methods and equipment, Hyatt Roller Bearing Co., Harrison, N. J.

CONNELL, E. B., supervisor lub. sales, Union Oil Co. of California, Los Angeles, Cal.

DELONG, LUTHER A., service manager, Topton Motor Co., Topton, Pa.

FAHRNEY, EARLE G., 623 Fair Oaks Ave., Oak Park, Ill.

GOLDSMITH, LESTER M., consulting engineer, The Atlantic Refining Co., Philadelphia, Pa.

GREENSHIELDS, R. J., Shell Petroleum Corp., Wood River, Ill.

GREGORY, ALFRED THORNE, test engineer, Wright Aeronautical Corp., Paterson, N. J.

KAUFFMANN, ALFRED, 231 West 96th St., New York City.

LACHAPELLE, ROBERT LESTER, teacher, St. Cloud Reformatory, St. Cloud, Minn.

MITCHELL, H. WALTER, service engineer, United Motors Service, Pittsburgh, Pa.

NARGI, JOHN J., draftsman, Chevrolet Motor Co., Detroit.

OLIVER, FRANK J., JR., industrial coordinator, College of Engineering, University of Detroit, Detroit.

OSGOOD, W. B., sales agent, Globe Steel Tubes Co., Milwaukee, Wis.

WHEATON, FLOYD L., acting superintendent auto maintenance, City of Detroit, Department of Street Railways, Detroit.

YOUNG, THOMAS ALEXANDER CRAWFORD, equipment manager, Irish Shell, Ltd., Dublin, Ireland.

Engine Types Adapted to Car Trends

(Continued from page 17)

ment this type will be found to have advantages not only in the amount of material needed, but in many other respects. Castings are simplified, consequently scrap losses will be reduced. The individual cylinders could be designed for manufacture on automatic machines. A line of engines of different power could be run over practically the same tools by using the same mechanism in five-, seven- and nine-cylinder grouping. Tool investment would be reduced and servicing simplified.

In discussing these various engines, it was not deliberately intended to make a case for any of them, although, with justice, may be found some partiality to the radial engine. I hope, however, that I have been able to present some of the obvious advantages in attractive enough light to encourage automobile engineers to investigate their possibilities further.

There is no desire to become involved in the controversy over engine location, but I cannot refrain from expressing the conviction that if existing types of engines are retained, they should be left where they are. A radical departure in automobile design would be of questionable merit, unless sufficient advancement of the art were accomplished by it to render existing cars obsolete, and thereby stimulate sales enough to justify the large expense involved. For this reason, such a change as moving the engine from the front to the back is likely to produce disappointing results, unless the design incorporates a power plant especially adapted to the new structure and arrangement of the car.

Appendix

In the accompanying tabulation of the inertia balance and firing intervals of engines of the types specified, the meaning of the symbols used is as follows:

C = Centrifugal force, in inch-pounds, that would be obtained by rotating the reciprocating weight of one cylinder with crank speed at crank radius.

W = Value of the centrifugal force produced by the counterweight necessary to cancel all or part of the inertia forces. The primary weight is supposed to run with the same speed and in the same direction as the crankshaft. The secondary weight runs twice as fast and in the same direction, unless otherwise noted. The angular position of the weights with respect to the crankpin is indicated in the diagram by P and by s, respectively.

H = The horizontal unbalanced inertia resultant after the counterweight indicated has been incorporated.

V = The vertical unbalanced inertia resultant after the counterweight indicated has been incorporated.

Θ = Crank angle, measured from the crank position as shown, in a clockwise direction

a = Distance in inches as shown

b = Distance in inches as shown

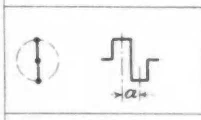
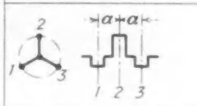
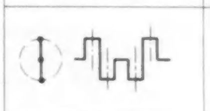
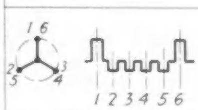
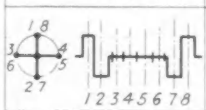
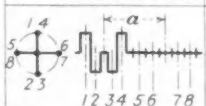
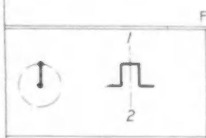
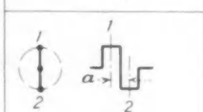
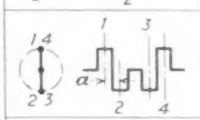
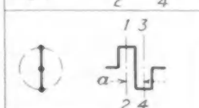
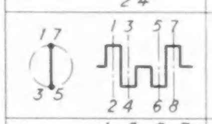
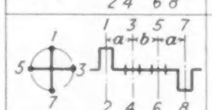
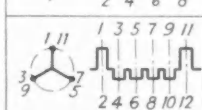
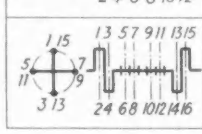
c = Distance in inches as shown

M_v = Rocking couple, in inch-pounds, in the vertical plane. A positive couple turns clockwise in the top view or the side view, as shown

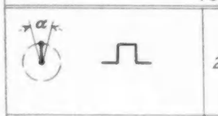
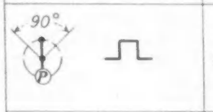
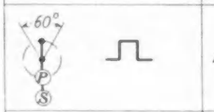
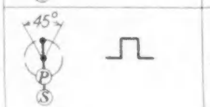
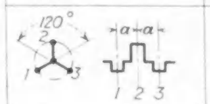
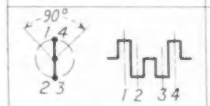
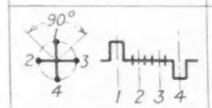
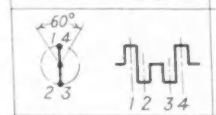
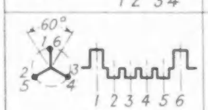
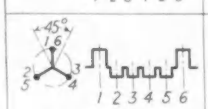
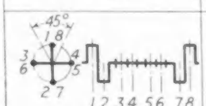
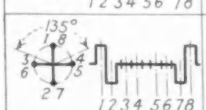
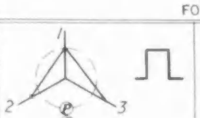
M_h = Rocking couple, in inch-pounds, in the horizontal plane. A positive couple turns clockwise in the top view or the side view, as shown

λ = Ratio of crank radius divided by connecting-rod length

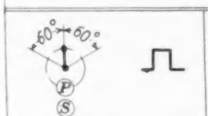
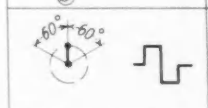
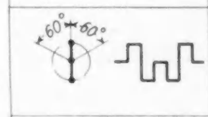
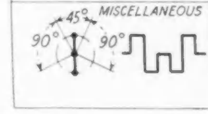
INERTIA BALANCE AND FIRING INTERVALS

ARRANGEMENT OF CRANKSHAFT AND CYLINDERS	NO. OF CYL.	PRIMARY SHAKING FORCE	PRIMARY ROCKING COUPLE	SECONDARY SHAKING FORCE	SECONDARY ROCKING COUPLE	FIRING INTERVAL, DEG.
FOUR-CYCLE IN-LINE ENGINES						
	1	$W=0$ $V=C\cos\theta$ $H=0$	$M=0$	$W=0$ $V=\lambda C\cos 2\theta$ $H=0$	$M=0$	720
	2	$W=0$ $V=0$ $H=0$	$M_V=aC\cos\theta$	$W=0$ $V=2\lambda C\cos 2\theta$ $H=0$	$M=0$	180 540
	3	$W=0$ $V=0$ $H=0$	$M_V=a\sqrt{3}C\sin\theta$	$W=0$ $V=0$ $H=0$	$M_V=a\sqrt{3}\lambda C\sin 2\theta$	240
	4	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=4\lambda C\cos 2\theta$ $H=0$	$M=0$	180
	6	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	120
	8	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	90
	8	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M_V=4\lambda C\cos 2\theta$	90
FOUR-CYCLE OPPOSED ENGINES						
	2	$W=0$ $V=2C\cos\theta$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	180 540
	2	$W=0$ $V=0$ $H=0$	$M_V=aC\cos\theta$	$W=0$ $V=0$ $H=0$	$M_V=a\lambda C\cos 2\theta$	360
	4	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M_V=2a\lambda C\cos 2\theta$	180
	4	$W=0$ $V=0$ $H=0$	$M_V=2aC\cos\theta$	$W=0$ $V=0$ $H=0$	$M=0$	180
	8	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	180 2 CYLS. SIMULT.
	8	$W=0$ $V=0$ $H=0$	$M_V=2(2a+b) \times C\cos\theta - 2bC\sin\theta$	$W=0$ $V=0$ $H=0$	$M=0$	90
	12	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	60
	16	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	90 2 CYLS. SIMULT.

INERTIA BALANCE AND FIRING INTERVALS

ARRANGEMENT OF CRANKSHAFT AND CYLINDERS	NO. OF CYL.	PRIMARY SHAKING FORCE	PRIMARY ROCKING COUPLE	SECONDARY SHAKING FORCE	SECONDARY ROCKING COUPLE	FIRING INTERVAL, DEG.
FOUR-CYCLE V-TYPE ENGINES						
	2	$W=0$ $V=2C\cos\theta \times \cos^2\alpha/2$ $H=2C\sin\theta \times \sin^2\alpha/2$	$M=0$	$W=0$ $V=2\lambda C\cos 2\theta \times \cos\frac{\alpha}{2}\cos\alpha$ $H=2\lambda C\sin 2\theta \times \sin\frac{\alpha}{2}\sin\alpha$	$M=0$	
	2	$W=C$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=\sqrt{2}\lambda C \times \cos 2\theta$	$M=0$	450 270
	2	$W=\frac{1}{2}C$ $V=C\cos\theta$ $H=0$	$M=0$	$W=\frac{1}{2}\sqrt{3}\lambda C$ $V=0$ $H=0$	$M=0$	420 300
	2	$W=0.293C$ $V=\sqrt{2}C \times \cos\theta$ $H=0$	$M=0$	$W=0.541\lambda C$ $H=0$ $V=0.765\lambda C \times \cos 2\theta$	$M=0$	405 315
	6	$W=0$ $V=0$ $H=0$	$M_V=\frac{1}{2}a\sqrt{3} \times C\sin\theta$ $M_H=\frac{3}{2}a\sqrt{3} \times C\cos\theta$	$W=0$ $V=0$ $H=0$	$M_V=\frac{1}{2}a\sqrt{3} \times \lambda C\sin 2\theta$ $M_H=\frac{3}{2}a\sqrt{3} \times \lambda C\cos 2\theta$	120
	8	$W=C$ * $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=4\sqrt{2}\lambda C \times \cos 2\theta$	$M=0$	90
	8	$W=C$ * $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	90
	8	$W=0$ $V=0$ $H=0$ * OPPOSITE EACH CRANK	$M=0$	$W=2\sqrt{3}\lambda C$ $V=0$ $H=0$	$M=0$	60 120 60 120 ETC.
	12	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	60
	12	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	45 75 45 75 ETC.
	16	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	45
	16	$W=0$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	45
FOUR-CYCLE RADIAL ENGINES; NO LINK RODS						
	3	$W=1\frac{1}{2}C$ $V=0$ $H=0$	$M=0$	$W=1\frac{1}{2}\lambda C$ REVERSE ROTATION $V=0$ $H=0$	$M=0$	240
n CYLINDER RADIAL SINGLE ROW n = ODD $n>3$	n	$W=\frac{n}{2}C$ $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	$\frac{720}{n}$
DOUBLE ROW RADIAL n CYLINDERS PER ROW n = ODD OR EVEN 180-DEG. CRANK PHASE ANGLE BETWEEN ROWS = $\frac{360}{2n}$	$2n$	$W=\frac{n}{2}C$ EACH ROW $V=0$ $H=0$	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	$\frac{720}{n}$

INERTIA BALANCE AND FIRING INTERVALS

ARRANGEMENT OF CRANKSHAFT AND CYLINDERS	NO. OF CYL.	PRIMARY SHAKING FORCE	PRIMARY ROCKING COUPLE	SECONDARY SHAKING FORCE	SECONDARY ROCKING COUPLE	FIRING INTERVAL, DEG.
FOUR-CYCLE RADIAL ENGINES; WITH LINK RODS						
SINGLE ROW SINGLE CRANK n CYLINDERS $n>3$ r = DISTANCE CRANKPIN TO KNUCKLE PIN l = LENGTH OF LINKROD L = LENGTH OF MASTER ROD CONDITIONS: 1. r = CONSTANT 2. $L=r+l$ 3. ANGLE BETWEEN KNUCKLE PINS IS SAME AS ANGLE BETWEEN CYLINDERS	n	$W=\frac{n}{2}C$ $V=0$ $H=0$	$M=0$	$W=n\frac{r}{l}\lambda C$ SAME SIDE AS CRANKPIN WHEN MASTER ROD IS IN TOP DEAD CENTER $V=0$ $H=0$	$M=0$	$\frac{720}{n}$
FOUR-CYCLE W-TYPE ENGINES						
	3	$W=1\frac{1}{2}C$ $V=0$ $H=0$	$M=0$	$W=\frac{1}{2}\lambda C$ $V=0$ $H=\lambda C\sin 2\theta$	$M=0$	120 300 300
	6	$W=1\frac{1}{2}C$ * $V=0$ $H=0$	$M=0$	$W=\lambda C$ $V=0$ $H=2\lambda C \times \sin 2\theta$	$M=0$	120
	12	$W=0$ $V=0$ $H=0$	$M=0$	$W=2\lambda C$ $V=0$ $H=4\lambda C \times \cos 2\theta$	$M=0$	60
MISCELLANEOUS 	16	$W=0$ $V=0$ $H=0$ * OPPOSITE EACH CRANK	$M=0$	$W=0$ $V=0$ $H=0$	$M=0$	45

Discussion

Reviews Pros and Cons Of Barrel-Type Engine

—E. S. Hall
New Haven, Conn.

MR. KALB'S statement that accessibility in V-type engines is not good does not always hold true. Accessibility of the Ford V-8 engine is better than that of the in-line engine, since all valves and bearings can be got at from top or bottom. If the Ford V-8 engine were used in the Chrysler air-flow car, it would not be necessary to pull off a front wheel for any service operations on the engine.

Barrel engines are not suitable for present conventional automobiles. An engine the shape of a beer keg with spark plugs scattered about both ends, slung low between the frame members, is not very attractive. For future types of automobiles, the compact barrel engine may be more promising, particularly if it can provide definitely superior performance. Can superior performance be obtained?

Most engineers assume that the barrel engine is unavoidably inefficient. They visualize high friction-losses similar to those encountered in trying to turn a nut by pushing axially on the screw. "The power has to go around a corner."

What of it? All the power applied to a mechanism comes out the other end except what is lost in friction, and friction losses in a properly constructed barrel engine need be no higher and may be less than in the crank mechanism.

The friction losses in the journal bearings of the crank mechanism are accepted as reasonable in spite of increasing difficulties with connecting rods. Lubrication conditions in the journal bearings of the crank mechanism are very much less perfect than those in the pivoted-slipper thrust bearing, so that when the journal-bearing connecting-rod mechanism is replaced by a suitable Kingsbury or Michell thrust-bearing mechanism, as in the barrel engine, the friction losses may be lower, in spite of the heavier total load which must be carried owing to the fact that the gas load on the connecting rod big end, $P \sec \alpha$, is a function of connecting rod angularity, which varies, while in the similar expression for loading on the wabbler or swash-plate bearing, the angle α is the plate angularity, which is fixed and equal approximately to the maximum connecting-rod angularity. This more continuous total loading is the only price which must be paid for substituting the barrel engine mechanism for the crank mechanism, and it is more than offset by the fact that film lubrication conditions in the slipper thrust-bearing are so far superior to those in journal bearings. It is possible, therefore, by means of a suitable application of the slipper-thrust-bearing principle, to build barrel engines as efficient mechanically as any crank engine for the same purpose.

At once the question arises: "If so, with all the work that has been done on barrel engines, why haven't any of them succeeded?" There are several reasons of which I may mention three: (1) Realization of the necessity of applying the pivoted-slipper thrust-bearing principle is comparatively recent. All previous attempts were doomed to failure and gave the whole class a black eye. No known cam mechanism has ever been successfully applied to the barrel-engine mechanism, and probably none ever will be. It is a waste of time and money to build cam engines. (2) It is easier for an enthusiastic inventor who has not thought the job through, to finance an engine of a type which cannot succeed, than for an engineer who knows the difficulties to get the same backing. Witness the many cam engines which have been built, to say nothing of the bevel-gear jobs. (3) Again, the attempt to build barrel engines with poppet valves, according to the policy of "one thing at a time," has been disappointing. The operating mechanism is always junky, and proper manifolding is almost impossible. Poppet valves do not belong on barrel engines and must be ruled out before successful barrel engines can be built.

Success with barrel engines depends on the intelligent use of slipper thrust-bearings plus either the opposed-piston two-stroke cycle which needs no valves, or some form of rotary or hypotrochoidal valve.

The opposed piston two-stroke cycle is accepted as right for Diesel engines. It requires two engine mechanisms with a single cylinder block between, and some form of blower.

The normal barrel engine with a single engine mechanism between two cylinder blocks is even more attractive. Especially in two-stroke cycle, bearing conditions may be much more favorable since piston inertia loading may be almost totally absorbed by gas pressure loading, the engine mechanism carrying only the loads which produce the useful torque. It is necessary, however, to accept a new valve system with the new engine mechanism.

The barrel-engine cylinder arrangement is ideal for a rotary-valve system, a single rotor serving all the cylinders at one end of the engine. It is true that most rotary-valve experience has been sour, but a round valve is as much of a misfit on an in-line engine as a poppet is on a round engine, and it is therefore not surprising that the application of round valves to in-line engines has not been successful. At the present time, however, at least two practical rotary-valve systems exist, and it is safe to state that any intelligent engineering concern that seriously undertook the job, could produce fully practical rotary valves with everlasting dependability, within a reasonably short time.

The combination of a practical rotary valve system with the best barrel-engine mechanism can yield unique results not approachable in any other known way, such as the following:

(1) a construction so simple as to permit the lowest possible cost;

(2) pistons travelling straight in the cylinders, without cocking or slap, so that rings can maintain their function without impairment;

(3) extremely long life and dependability, the con rods and valve system being no longer limiting factors;

(4) absolutely uniform distribution;

(5) improved breathing capacity. With a valve system that practically takes off the cylinder head whenever the valve opens, volumetric efficiency ought to be improved enough to produce an entirely new order of specific performance.

As applied to automobiles of the future, such an engine would have first claim by virtue of superior performance at lower cost, and second claim by virtue of compact shape, wherever that shape would be an advantage, as for example, in avoiding any compromise of streamlining.

Nevertheless, a more promising application of the barrel engine is to aircraft, where the engine form and compactness are particularly suitable. For example, it is apparently possible to build an engine of 3500 cu. in. piston displacement with an overall length under 50 in., not including accessories, and a diameter not more than 30 in.—compactness not possible in any other known way. Pressure air cooling might be used in such an engine, but I am inclined to think that liquid cooling will prove to be more satisfactory.

Sounds Caution Note On Radial-Engine Use

—Robert Insley

Research Engineer,
United Aircraft & Transport Corp.

IT is true that weight and air-cooling facility are the two principal advantages of the radial engine for aeronautical service, but it seems unlikely that the second of those advantages will play a large part in the suitability of that type for automobile propulsion. Mr. Kalb has agreed that the overhead type of valve gear, because of noise, will probably have to be abandoned for automotive radial engines which (neglecting unconventional types) leaves the problem of air cooling an L-head radial engine, a task not pleasant to contemplate.

The radial engine achieves its weight advantage by gather-

ing as many cylinders as possible about a short shaft and so reducing shaft and case weight. That same process however makes difficult the problem of accessory drive. With the flywheel and clutch housing occupying one whole end of the engine, the accessories must all be located at the other end—there are no sides of a radial engine. The side view of an aircraft radial engine discloses the fact that by far the greater part of the length of the engine is that produced by accessories and I believe the same would be true of the radial engine for automobile propulsion. There seems to be little advantage in favor of this type so far as compactness is concerned when all the necessary accessories are added.

So long as the master and articulated rod construction is used, and I know of no reasonable method of avoiding it, the radial engine will have an inherent secondary unbalance. Mr. Kalb suggests that this be cancelled by a bob weight operating at twice crankshaft speed, but I wonder if the same difficulties which have kept the bob weight out of other engines which have needed it would not keep it out of the radial.

For small quantity production on all purpose machinery the radial engine is well suited, because it is a "round" engine and can be handled nicely on inexpensive fixtures. But where several thousand engines per day are required the job calls for very expensive special machinery. Mr. Kalb suggests practically automatic cylinder machining operations but with seven or nine individual cylinders involved the handling alone will represent nearly the whole cost of machining a single block. However, since the radial engine is inherently much lighter than the line engine, it is not at all impossible that the saving in material may offset the difference in machining cost.

Mr. Kalb's suggestion of using interchangeable cylinders for five, seven and nine-cylinder engines sounds very attractive and has been followed to some extent in aircraft engine manufacture but there is at least one strong argument against it. The bore-stroke ratio best suited for compactness and low weight in a five-cylinder engine is not at all the ratio best suited for a nine-cylinder engine. Consequently if this method is adopted two of the series of these engines are compromises and only one is a really good engine.

The matter of accessibility of a radial engine in the stern of an automobile is one to be approached prayerfully. With cylinders protruding in all directions it is difficult to imagine any arrangement which will permit all heads or plugs to be removed with equal or even reasonable facility.

Horizontal Engines Offer Some Points

—E. H. Hamilton

Professor in Charge of Automotive Engineering, New York University

MR. KALB'S review of the various types of engines suitable for automobile use was most interesting. One type which he seems to have omitted is the Horizontal Double-Opposed or, as it is sometimes referred to, the Two-Opposed-Piston Type. This engine, in spite of certain criticisms of the necessary gearing to synchronize the two crankshafts, has many outstanding advantages over certain other types of engine. As pointed out by Mr. Kalb, in his paper, a flat or horizontal engine would fit in rather well with our present ideas on streamlining.

I do not agree with the author regarding the proper place for the engine in the car. Placing it to the rear of the rear axle seems to me to be fundamentally wrong from every standpoint. It reduces the weight on the front end where weight is needed at high speeds; it increases the weight on the rear axle where no increase in weight is desired. It generally calls for a longer car and the only excuse that I can see for placing the engine in the rear is due to the fact that the ordinary type of engine will not easily fit into the front end of a streamlined vehicle. Any horizontal type of engine such as the double opposed-piston type will fit nicely into the front end of most any streamlined car. This type of engine is, of course, in perfect balance when built up in any even number of pistons.

This type of engine can be built to operate either as a two-cycle or as a four-cycle engine. When designed as a four-cycle unit, a single reciprocating sleeve worked in conjunction with two pistons will take care of the exhaust and intake events. When run as a two-cycle engine the sleeve can be omitted and each piston in a cylinder will take care of one of these events. My experience with this type of engine has led me to believe that it holds considerable promise for automobile as well as aircraft use.

One question that I would like to ask Mr. Kalb is how he proposes to take care of the oil that undoubtedly would tend to get into the lower cylinder or cylinders of his radial engine when the engine is idling or running at relatively low speeds. My experience with tests on radial engines has been that the oil will accumulate in the lower cylinders whenever the speed of the pistons is so low that the upward acceleration given to the oil by the piston is less than the acceleration due to gravity. Above this speed, of course, the acceleration given to the oil by the pistons in the lower cylinders throws the oil clear and thus prevents any accumulation. The radial aircraft engines operate with sufficiently high piston speeds so that they are not troubled by this oil problem.

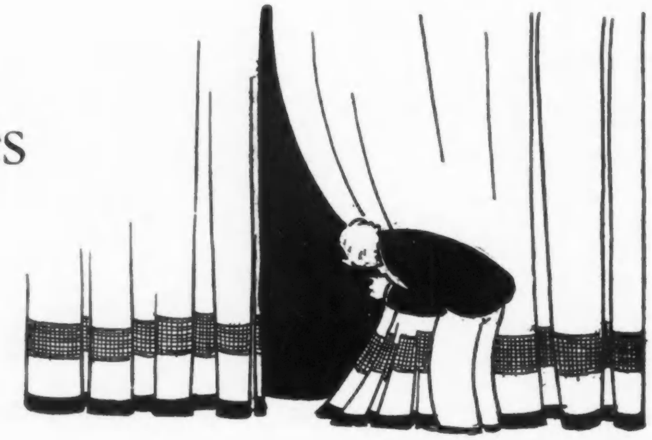
I cannot agree with Mr. Kalb that distribution of a wet mixture would be made any easier on a radial than on a conventional type of engine. Making the paths from the carbureter to each cylinder of equal length would not in any way equalize distribution unless all of the equal length paths had the same slope. As a matter of fact, on the engine which he describes, half of these branches would run up hill and the other half would run down hill from the carbureter. All of the experience that I have had with radial engines would lead me to believe that the lower cylinders would receive an over-rich wet mixture and the upper half, especially the uppermost cylinder, would receive a comparatively lean dry mixture. Mixture distribution on such an engine obviously would be very poor unless some mechanical device such as a centrifugal supercharger element were used to aid in equalizing the distribution.

Erratum

In the report of the 1934 Cooperative Road Tests published in the September, 1934, S.A.E. JOURNAL, reference was erroneously made on page 15 to the meeting of the Cooperative Fuel Research Committee held Sept. 12, 1933. The correct date of this meeting was Sept. 12, 1932.

Behind the Scenes

With the Committees



Color Code for Steel Bars

IN response to a recent request from the National Association of Purchasing Agents, the Iron and Steel Division of the Standards Committee, appointed a subdivision to consider the pros and cons of adopting an S.A.E. color code for marking steel bars. Such a color code was not deemed practical by the subdivision which reported unfavorably on the project. In its report the subdivision said:

"The subdivision believes that individual companies should experience no difficulty in having their various types of steel bars painted the proper colors for their individual requirements, in other words, continuing with their present practice rather than attempting to work to some standard color code such as suggested. It is the opinion of the subdivision that a great many large users of steel in this country would not change their present color code scheme regardless of any action by the S.A.E., considering that more distinctive colors can be used on their own materials because of the lesser number of types of steel used in their own plants.

"A color code covering the very large number of S.A.E. steels listed will be so extremely complicated due to the small number of colors that can be used, that a great deal of confusion will surely result should the Society attempt to cover all of these types of steels as represented by the N.A.P.A. The matter of painting bars while hot will also complicate matters.

"The subdivision therefore reports that it is not deemed practical to adopt a color code as proposed by the National Association of Purchasing Agents, for the marking of steel bars, and recommends that this subject be discontinued."

The recommendation by the subdivision has been submitted to the entire division and approved by it.

Members of the subdivision making the report were: A. H. D'Arcambal, Pratt & Whitney Co., Chairman; N. L. Deuble, Republic Steel Corp.; G. E. Knable, Carnegie Steel Co.

A proposal to establish a telegraphic code for ordering S.A.E. steels has also been reported unfavorably because of the tremendous amount of work involved in the preparation of such a code and the difficulties which would be encountered with respect to international rules and telegraphic codes, etc.

As this issue of the JOURNAL was being prepared for the press, the Iron and Steel Division of the Standards Committee was meeting in Detroit (Sept. 17 and 18), to act on reports on various subdivisions that are preparing extensions and revisions in the S.A.E. Iron and Steel specifications to bring them up to date.

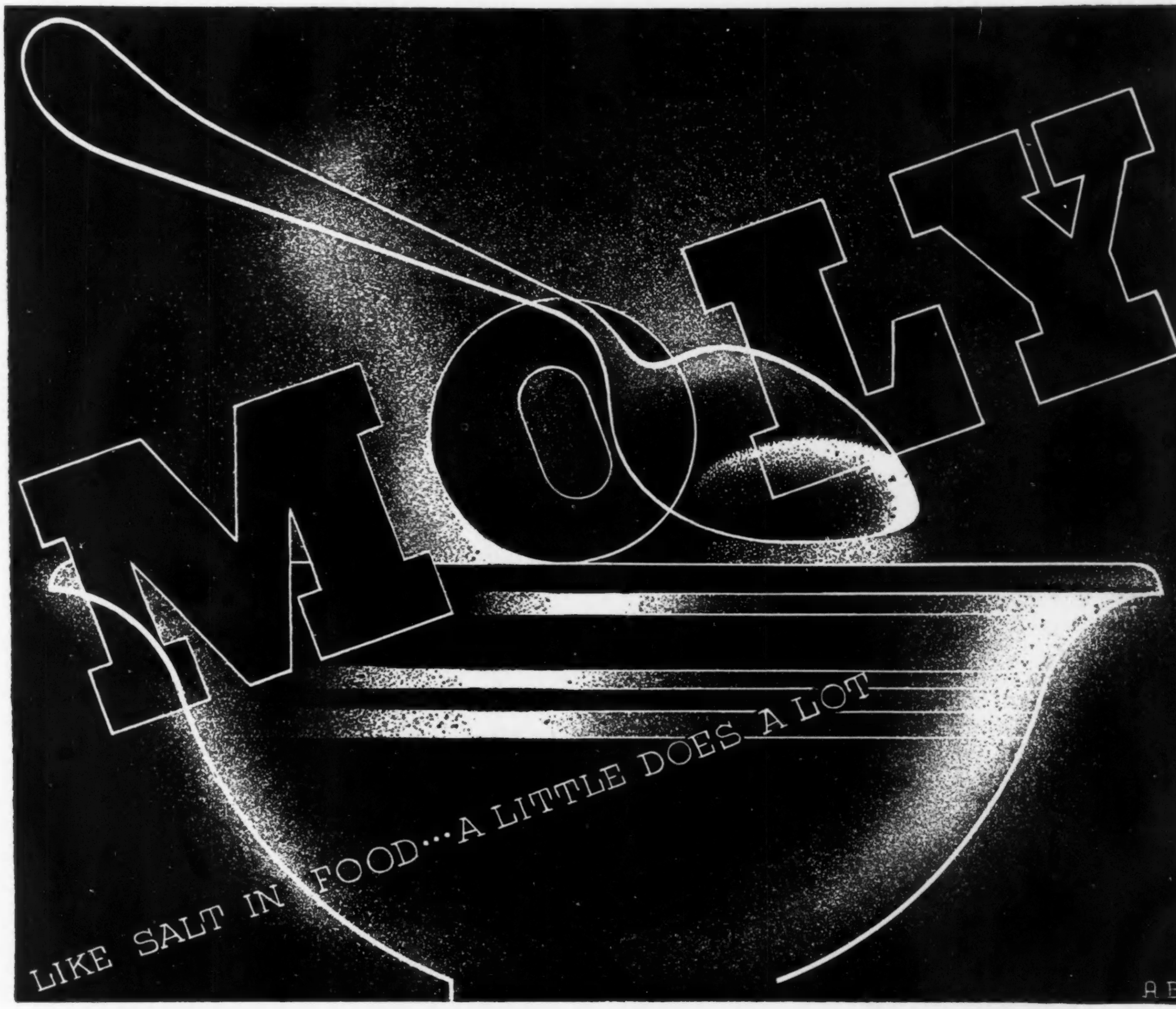
Lubricants

AT a meeting of the Lubricants Division of the Standards Committee on June 21, at Saranac Inn, a report was presented on the results of the letter ballot on the status of the 10-W and 20-W crankcase oils. On the question of whether the 10-W or 20-W oils should be advanced to the recommended practice classification, the letter ballot resulted in their retaining their present tentative status. Automobile men answering the letter ballot were largely in favor of advancing the oils to the classification of S.A.E. Recommended Practice while the vote of the lubricant members of the Division was about evenly divided.

On the question of whether it is desirable to cancel the S.A.E. No. 10 classification, automobile representatives expressed themselves as in favor of it while the petroleum vote was again evenly divided. An alternative of leaving this question for later action resulted in a slight plurality favoring such delay with the result that the classification is at present being retained.

The question of whether it is desirable to cancel the S.A.E. No. 20 classification brought a slight plurality in favor of such cancellation with most of the automobile men in favor and about two-thirds of the petroleum men not in favor of it. The proposal of later action on this cancellation was received favorably by a majority of voters and the question was thereupon referred to a subdivision for further consideration.

Later in the meeting a subdivision was appointed to study and report back recommendations on the entire classification of S.A.E. crankcase oils with reference to their viscosity limits. Members of the subdivision were named as follows: H. C. Mougey, General Motors Corp.. Chairman; A. L. Clayden, Sun Oil Co.; J. C. Geniesse, Atlantic Refining Co.; W. H. Graves, Packard Motor Car Co.; G. M. Maverick, Standard Oil Development Co.; K. G. Mackenzie, The Texas Co.


MOLY
LIKE SALT IN FOOD...A LITTLE DOES A LOT
A B

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Aerodynamic Theory

By William Frederick Durand. Published by Julius Springer, Berlin, 1934; 398 pp. [A-1]

During the active life of the Guggenheim Fund for the Promotion of Aeronautics provision was made for the preparation of a series of monographs on the general subject of Aerodynamic Theory. It was recognized that in its highly specialized form, as developed during the past twenty-five years, there was nowhere to be found a fairly comprehensive exposition of this theory, both general and in its more important applications to the problems of aeronautic design. It was hoped therefore that this series of monographs would provide a general review of progress during the past quarter century, thus covering substantially the period since flight in heavier-than-air machines became an assured fact.

The first volume is largely taken up with material dealing with special mathematical topics and with fluid mechanics. The purpose of this material is to furnish, close at hand, brief treatments of special mathematical topics which, as a rule, are not usually included in the curricula of engineering and technical courses and thus to furnish to the reader some of the elementary notions of various mathematical methods and resources, of which much use is made in the development of aerodynamic theory.

A Flight Investigation of the Effect of Mass Distribution and Control Setting on the Spinning of the XN2Y-1 Airplane

By N. F. Scudder. N.A.C.A. Report No. 484, 1934; 10 pp., with tables and charts. Price, 5 cents. [A-1]

Effect of Retractable-Spoiler Location on Rolling- and Yawing-Moment Coefficients

By J. A. Shortal. N.A.C.A. Technical Note No. 499, July, 1934; 12 pp., 5 figs. [A-1]

The Torsional Stiffness of Thin Duralumin Shells Subjected to Large Torques

By Paul Kuhn. N.A.C.A. Technical Note No. 500, July, 1934; 8 pp., 14 figs. [A-1]

Landing-Shock Recorder

By M. J. Brevoort. N.A.C.A. Technical Note No. 501, July, 1934; 8 pp., 8 figs. [A-1]

Aerodynamic Investigation of a Cup Anemometer

By John D. Hubbard and George P. Drescoll. N.A.C.A. Technical Note No. 502, July, 1934; 24 pp., 19 figs. [A-1]

Measurement of Altitude in Blind Flying

By W. G. Brombacher. N.A.C.A. Technical Note No. 503, August, 1934; 34 pp., 10 figs. [A-1]

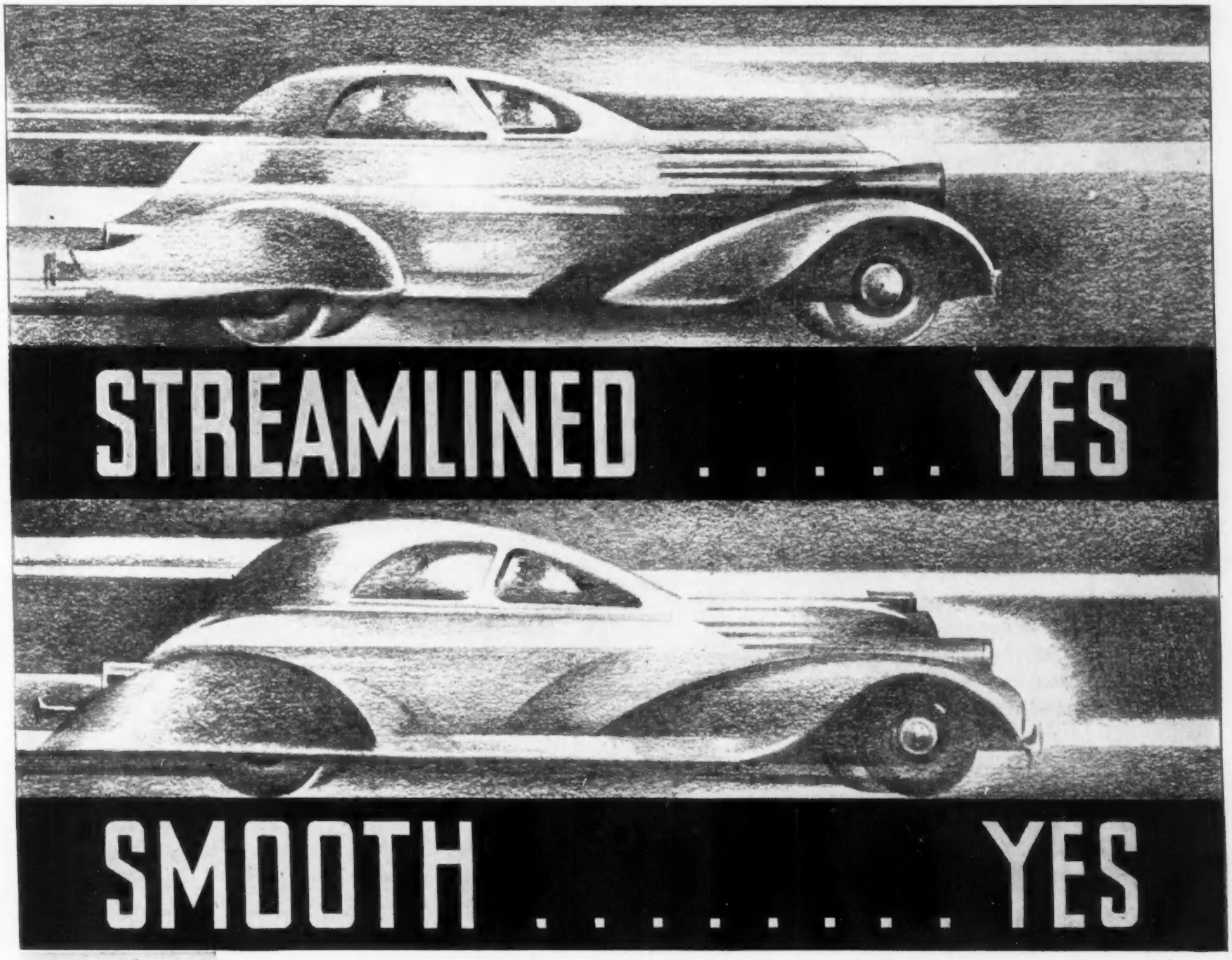
An Investigation of the Stress Distribution Due to Bending and Torque in the Boeing XP-9 Semi-Monocoque Fuselage

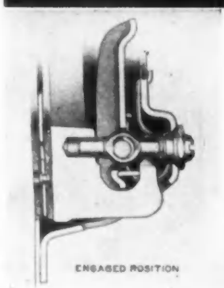
Prepared by C. G. Brown. Air Corps Technical Report No. 3655. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 18 pp., with tables and charts. [A-1]

Comparison of Various Methods of Predicting Effect of Propeller on Diving Speed

Prepared by R. E. Middleton. Air Corps Technical Report No. 3872. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 4 pp., with figures. [A-1]

(Continued on page 34)


STREAMLINED . . . . . YES
SMOOTH . . . . YES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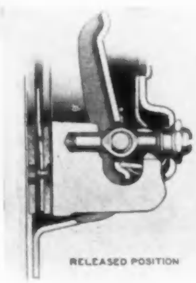
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NOTES AND REVIEWS

Continued

Influence of Cut-Outs in Elevator on the Static Longitudinal Stability and on the Static Elevator Effect

By Curt Biechteler. Translated from *Luftfahrtforschung*, Vol. XI, No. 1, May 15, 1934. N.A.C.A. Technical Memorandum No. 750, August, 1934; 4 pp., 13 figs. [A-1]

Investigation of Boundary Layers on an Airplane in Free Flight

By J. Stüper. Translated from *Luftfahrtforschung*, Vol. XI, No. 1, May 15, 1934. N.A.C.A. Technical Memorandum No. 751, August, 1934; 10 pp., 11 figs. [A-1]

Additional Test Data on Static Longitudinal Stability

By Walter Hübner. Translated from *Luftfahrtforschung*, Vol. XI, No. 1, May 15, 1934. N.A.C.A. Technical Memorandum No. 752, August, 1934; 22 pp., 30 figs. [A-1]

Airplane Vibrations and Flutter

Prepared by J. A. Roché. Air Corps Technical Report No. 3861. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 7 pp., illustrated. [A-1]

Flutter Control Devices

Prepared by M. N. Pack. Air Corps Technical Report No. 3875. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 2 pp., with figures. [A-1]

Spot Welding and Its Application to Aircraft Structure Corrosion-Resistant Steel 18:8

Prepared by Charles L. Hibert. Air Corps Technical Report No. 3907. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 7 pp., illustrated. [A-1]

Impact Buckling of Thin Bars in the Elastic Range for Any End Condition

By Josef Taub. Translated from *Luftfahrtforschung*, Vol. X, No. 2, July 6, 1933; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 749, July, 1934; 60 pp., 22 figs. [A-1]

ENGINES

Engine Knock—A Study of the Pressure Waves Associated with Detonative Burning

By Lloyd Withrow and Gerald M. Rassweiler. Published in *The Automobile Engineer*, August, 1934, p. 281. [E-1]

In connection with a study of the flame movements at the time of knock and more recently in the interpretation of absorption spectra of the gases in an Otto cycle engine a considerable number of time-displacement records of flame movements were photographed in an engine running under its own power and pulling a normal load. Pressure-time curves were obtained simultaneously with the majority of the flame records. This photographic study of engine combustion covered a wide variety of operating conditions.

The paper describes the apparatus used and presents a group of pictures illustrating one phenomenon; namely, shock waves.

On the basis of the evidence set forth, the following conclusions were reached: (1) that the dominant pressure fluctuations observed on the indicator cards taken with the carbon-stack indicator result from real pressure fluctuations in the engine, and (2) that the inference previously drawn from the flame pictures alone, that pressure waves are sometimes set up in an engine running under knocking conditions, is correct.

Equilibrium Volatility of Motor Fuels from the Standpoint of Their Use in Internal Combustion Engines

By Oscar C. Bridgeman. Published in the *Bureau of Standards Journal of Research*, July, 1934, p. 53. [E-1]

The author states that one of the larger problems in connection with the relation between fuel characteristics and engine performance is concerned with fuel volatility. For many years, the National Bureau of Standards conducted an investigation of fuel volatility, in cooperation with the automotive and petroleum industries, and the present paper covers the experimental data obtained and the conclusions reached in this investigation. An apparatus and method are described for the measurement of the equilibrium volatility of motor fuels, and experimental data are presented on 38 gasolines and blends covering a wide range of volatility. A correlation is shown to exist between equilibrium volatility data and distillation data obtained by the standard A.S.T.M. method. By use of the equations deduced, it is possible to obtain from distillation data all of the equilibrium volatility data of interest in connection with engine performance.

(Continued on page 36)

NOTES AND REVIEWS

Continued

The Use of Induction Cut-Off for Power Control of Internal-Combustion Engines

By Edmund Giffen. Published in *Engineering*, August 24, 1934, p. 186. [E-1]

A series of comparative tests on the relative merits of the induction cut-off and throttling methods of control were carried out on a Crossley gas engine in the Engineering Laboratory of King's College, London. Systematic tests were conducted on this engine, and a comparison made between control by throttling and by induction cut-off at four different compression ratios, and at three different mixture strengths for each compression ratio.

The tests described and discussed in this article show that, with the type of engine used, the change to cut-off control leads to a substantial improvement in performance.

Calculation of Horsepower Available

By Shatswell Ober. Appendix to Estimation of the Variation of Thrust Horsepower With Air Speed. N.A.C.A. Technical Note No. 446 (Appendix), July, 1934; 2 pp. [E-1]

Exhaust Gases and Other Products of Combustion in Airplane Engines and Their Effect on Man

Prepared by Major Malcolm C. Grow. Air Corps Technical Report No. 3954. Published by the Chief of the Air Corps, City of Washington; July 10, 1934; 6 pp. [E-1]

A Development of the Michell's Theory of Lubrication

By Torao Kobayashi. Report No. 107 of the Aeronautical Research Institute, Tokyo Imperial University, June, 1934; 60 pp., with tables and charts. [E-1]

On the Effect of Pipe Bores on the Cut-off of Fuel Spray in Injection Systems with Open Nozzles

By Fujio Nakanishi, Masaharu Itû, and Kikuo Kitamura. Report No. 108 of the Aeronautical Research Institute, Tokyo University, June, 1934; 19 pp., with tables and charts. [E-1]

HIGHWAYS

Auto et Route

By N. Bernatzky. Published in *La Technique Automobile et Aérienne*, 2nd quarter, 1934, p. 33. [F-1]

The following topics are to be dealt with in this series of articles on the mutual adaptation of the road to the vehicle: the width of the road and the automobile; road crowning and the chassis modifications thereby imposed; tractive resistance on curves; relation between the type of curve and the design characteristics of the vehicle; grades, the principles governing their choice and their effect on visibility. A number of original formulas are developed.

MATERIAL

The Corrosion of Tin and Its Alloys—Part I—The Tin-Rich Tin-Antimony-Copper Alloys

By T. P. Hoar. [G-1]

The Influence of Pickling on the Fatigue-Strength of Duralumin

By H. Sutton and W. J. Taylor. [G-1]

Permissible Stress Range for Small Helical Springs

By F. P. Zimmerli. Engineering Research Bulletin No. 26, July, 1934. Published by the Department of Engineering Research, University of Michigan, Ann Arbor, Mich. [G-1]

This study of the available stress ranges to which commercial steels can be subjected when tested as small helical compression springs leads to the following conclusions, the authors state:

(a) There is a definite relationship between the ultimate torsional strength and the available stress range in uniform steels. This is constant for each type of steel.

(b) The endurance limit or stress range of a given steel in torsion is raised by any treatment that increases the ultimate torsional strength.

(c) At present both foreign and domestic production are open to improvement since the maximum fatigue resisting properties are not always supplied.

(d) If the same ultimate torsional strength is imparted to a given steel in one instance by thermal treatment and in another by mechanical working, then the maximum resistance to fatigue will occur in the heat-treated condition.

(Concluded on page 38)


HERCULES
DIESEL ENGINES
Hercules Diesel Engines are simple, compact and rugged. Their success today in a wide variety of applications is due to their ability to deliver dependable and economical power . . . an ability characteristic of *all* Hercules Engines.
HERCULES MOTORS CORPORATION, CANTON, OHIO, U. S. A.
MANUFACTURERS OF HEAVY-DUTY INTERNAL COMBUSTION ENGINES AND POWER UNITS
FROM 6 TO 200 HORSEPOWER

NOTES AND REVIEWS

Concluded

Hydrocarbon Oils—Molecular Weights by the Cryoscopic Method and from Thermal Data

By M. R. Fenske, W. B. McCluer, and M. R. Cannon. Published in *Industrial and Engineering Chemistry*, September, 1934, p. 976. [G-1]

Average molecular weights of complex high-boiling hydrocarbon mixtures were obtained by a method based on heats of vaporization. This permits an independent check on the cryoscopic method of molecular weight determinations. Using six different oils, the greatest difference between the two methods was found to be 7 per cent. The average molecular weights of fourteen different hydrocarbon oil fractions were determined satisfactorily by the method involving heats of vaporization. These data were correlated on the basis of viscosity index and 37.8°C. (100°F.) Saybolt viscosity by the following equation:

$$\text{Mol. wt.} = 240 + \frac{32{,}310 \log_{10} \dfrac{100^\circ\text{F. viscosity}}{28.0}}{305 - \text{viscosity index}}$$

The Explosion of Mixtures of Combustible Gases with Air by Nuclear Drops of Water and Other Nuclei and by X-rays

By R. O. King. Published in the *Journal of the Institution of Petroleum Technologists*, August, 1934, p. 791. [G-1]

The author states that the nuclear theory of self-ignition as advanced by Callendar to account for the occurrence of detonation in an engine is based on the possession by nuclei present in a gaseous combustible mixture of chemical properties which, in the temperature conditions, lead to their simultaneous ignition and explosion before combustion is completed in the normal course of flame travel. The view that the nuclei, even if themselves incombustible, might ignite and explode the combustible mixture was not considered, but is supported by recent experiments. Thus mixtures with air of hydrogen, ethylene, carbonic oxide and acetylene have been exploded by nuclear drops of water, in suitable experimental conditions. The "conditions" depend mainly on the natures of the combustible gas and the contact surface. Experiments made with hydrogen-air mixtures passing through pyrex glass and steel combustions are described.

What Members Are Doing

Col. Porter Adams has been elected president of Norwich University, Northfield, Vt. Colonel Adams is a past president of the National Aeronautic Association, which he was active in founding, and has served continuously as chairman of its executive committee, except during the two terms he was its president. He has been a member of the S.A.E. since 1916,

Col. P. H. Adams

and has served on the Standards Committee from 1923 to 1926.

He is a member of the board of trustees of the Daniel Guggenheim Medal Fund and chairman of the Municipal Air Board of the City of Boston. As an engineer he has specialized in internal-combustion engine development and in aircraft problems. For the past several months he has been acting as president of Norwich University. His confirmation as permanent president was made after examination of a group of more than 30 candidates.

Leonard S. Hobbs, research engineer, Pratt & Whitney Aircraft Co., has been made a vice-president of the company under a reorganization plan recently announced.

Benjamin H. Gilpin, factory manager of Pratt & Whitney, has also been named a vice-president.

Mr. Hobbs joined the company as research engineer in 1927 and had been acting director of the company's research division for several years prior to his recent promotion. His previous connections have included work in the powerplant branch of the Army Air Corps laboratories at Cook Field and with the Stromberg Carburetor Co., where he was in charge of the aviation division.

Mr. Gilpin joined Pratt & Whitney as service manager in 1929. In 1930 he was appointed factory manager and for a time combined manufacturing and service responsibilities. Once with the Wright-Martin Co., Mr. Gilpin was chief inspector of all divisions. Just before joining Pratt & Whitney, he was quality manager and general manager respectively of the automobile and die-casting subsidiaries of the H. H. Franklin Mfg. Co.

Sidney Summerlee, formerly superintendent of the Chrysler plant at Newcastle, Ind., has formed Summerlee Sales and Service, Inc., in Detroit. The organization, of which he is president and treasurer, will sell and service automobiles and accessories.

Charles F. Magoffin is engineer, truck department (Dodge trucks), for the Chrysler Corp., Detroit.

Remember!

Change in passenger-car programs or in projects of parts and accessory makers usually has meant some movement of men between the various engineering departments. This is the time of year when many new programs are being developed.

The S.A.E. Placement Service, in touch with basic commercial movements as well as immediate personnel requirements in the industry, is constantly playing a more important part in helping engineering executives to select the men best fitted for their particular requirements and in seeking out the spots in which individual members of the Society can render their most effective service.

Donald H. Spicer, formerly research engineer with the Johns-Manville Corp., will have charge of sales and research for the Atlas Asbestos Co., North Wales, Pa.

Peter M. Heldt, author of a series of books on the design of gasoline engines and automotive vehicles, is the author of "High-Speed Diesel Engines," of which a French edition has recently appeared, and which will be

P. M. Heldt

issued in Italian and Spanish. Mr. Heldt, who has been a member of the Society since 1906, is engineering editor of *Automotive Industries.*

Charles Sardou, Jr., is inspector of assembly for the Douglas Aircraft Co., Santa Monica, Calif. He was formerly an inspector for the Lockheed Aircraft Corp. at Burbank, Calif.

George E. Denis is now engineer in charge of department, Young Radiator Co., Racine, Wis. Until recently he was chief engineer, Universal Motor Co., Oshkosh, Wis.

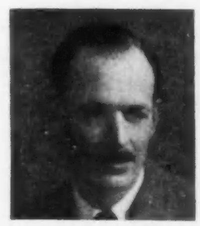
R. O. Ensign, formerly parts and service manager, American Austin Car Co., Inc., Butler, Pa., is now resident manager in Dallas, Tex., for the Chrysler Motors Parts Corp.

Richard R. Whittingham, formerly lubricating engineer in Boston for the Standard Oil Co. of N. Y., has joined the Gulf Refining Co., and has been assigned to the New York district. Mr. Whittingham was elected secretary of the New England Section for the 1935 season, but resigned on his transferring to residence in New York.

Bernhardt L. Dorman, formerly experimental engineer for the Paragon Vaporizer Corp., Chicago, is now special test engineer, tractor works laboratory, International Harvester Co., Chicago.

Maurice A. Thorne has become project engineer, Olds Motor Works, having resigned as experimental engineer, Pierce-Arrow Motor Car Co. Prior to joining Pierce-Arrow in 1929, he had been in charge of the proving ground for Studebaker Corp. for several years. He has been active in S.A.E. work, having been chairman of the Buffalo Section for 1932-33, as well

M. A. Thorne



as having served on various administrative and technical committees of the Society.

Arthur S. Hawks is now senior mechanical engineer (Diesel) with the United States Naval Engineering Experiment Station, Annapolis, Md. He was formerly chief engineer, Fairbanks, Morse & Co., Beloit, Wis.

Laurence K. Jenkins is connected with the Corbitt Co., Henderson, N. C.

C. W. Stratford, former president and general manager of Alco Products International, Paris, has formed the Stratford Engineering Corp. and will make his headquarters in Kansas City, Mo.

Axel J. Jansson has joined Vickers, Inc., Detroit, as a designer.

James Russell Walsh, formerly cooling-system engineer with the National Carbon Co., is now general manager of the Tri-Boro Electroplating Co., Corona, L. I., N. Y.

Hubert K. Dalton has moved his office to 522 Fifth Ave., New York City.

Walter E. Burnham, formerly instructor in aeronautics, Tri-State College, Angola, Ind., is now an engineer with the Stearman Aircraft Co., Wichita, Kan.

Roger Birdsell has been appointed manager of the new radiator division of the Yates-American Machine Co., Beloit, Wis. Formerly a vice-president of the old Perfex Corp., Mr. Birdsell has been, for the last several months, engaged in designing and equipping a plant for the production of tubular and cellular core radiators for the company with which he is now associated.

Roger Birdsell

Frederick Knack is working on a stress-analysis project for the Seversky Aircraft Corp., Farmingdale, New York.

Joseph E. Pogue, consulting engineer, is now located at 29 Washington Square, New York City.

Sydney Bevin, former manager of the sales engineering department, Tide Water Oil Co., has joined Fiske Brothers Refining Co., Toledo, Ohio, as chief engineer.

Conrad A. Teichert, formerly a designer with the Eclipse Aviation Corp., has joined the United American Bosch Corp., Springfield, Mass.

Kwang H. Chang is with the topographical division of the Department of Parks, New York City. He was formerly research engineer with the Dunbar-Gibson Co., New York.

Walter S. Rogers, formerly export service manager, White Co., Cleveland, has joined the service department of the Chrysler Export Corp. in Detroit.

William Van Der Sluys, Jr., is a student engineer with the Chrysler Corp., Detroit. Previously he was an assistant in the Department of Physics, Stevens Institute of Technology, Hoboken, N. J.

Leo A. Bixby is manager of the transmission division, Clark Equipment Co., Berrian Springs, Mich. Formerly he was chief engineer of the Fuller & Sons Mfg. Co., Kalamazoo, Mich.

L. H. Pomeroy, in his presidential address to the Institution of Automobile Engineers in London on Oct. 2, made the interesting suggestion that a major cause of accidents involving motor vehicles is road congestion. Designing vehicles to the ends of higher speed and acceleration might furnish an answer to the problem. The only other possible cure, he believes, would be to limit the number of vehicles on the road.

Personal Opinions

(Being terse phrases spoken or written by Members or by their guests and ferreted from their context by an editor in an inquiring mood)

When the R.A.C. formula for computing the horsepower of a gasoline engine was proposed, it was based on a maximum piston speed of 1000 ft. per min. The reasoning which led to this conclusion, as reported by Sir Dugald Clerk, was a trifle loose, but, as is well recognized by designers of large Diesel engines, piston speed constitutes a limitation, or rather a criterion by which the output of an engine should be judged. The questionable arguments presented and the failure of the R.A.C. formula to give even an approximately correct result have undoubtedly contributed to the disappearance of the use of piston speed as a criterion in aircraft-engine design. A powerful design tool has thereby been neglected.—*E. S. Taylor.*

Better results can be expected with the design of Metropolitan coaches where suitable engines are placed satisfactorily either in the front, rear or under the floor. They must be out of the passenger compartment, however. It is my opinion that with such engine placements, proper engine ratio will not only be achieved, but a clear interior space for the exclusive use of passengers will be provided.—*E. L. Tirrell.*

Although the high-power spark-ignition oil engine is a comparatively recent development, satisfactory results have been obtained, and it has been proved that the basic principles are sound. — *Torbjorn Dillstrom.*

The fact that streamlined articulated trains have been developed to meet special needs doesn't by any means indicate that previous types will no longer be desired. There are many services in which the passenger-carrying capacity is a secondary consideration, the principal revenue being obtained from express, milk, parcel post, and sometimes freight. Conventional types (of rail cars) will continue to be used and to make an excellent showing in such applications.—*Charles O. Guernsey.*

The evolution of all multi-cylinder engines has been influenced largely by the necessity for adaptation to the vehicles or machines in which they are used. In this respect there exists a close analogy between mechanical and biological evolution. This process of mechanical adaptation to environment is most strikingly exemplified by the wide divergence of automobile and aircraft engines.—*Lewis P. Kalb.*

Michael Gregor is president of the Gregor Aircraft Corp., Roosevelt Field, Mineola, L. I., N. Y. He was consulting aeronautical engineer for the Plane Speaker Corp., New York City.

Fred W. Parker, Jr., formerly sales engineer for the Timken-Detroit Axle Co., has been named service manager of the same organization.

Arthur S. Hawks, formerly chief engineer of Fairbanks, Morse & Co., is now senior mechanical engineer (Diesel) at the United States Naval Engineering Experiment Station, Annapolis, Md.

W. E. Lerch has been appointed chief technical instructor of the Hemphill Diesel Engineering Schools, Los Angeles, Calif. He was until recently mechanical supervisor of an estate in Greenwich, Conn.

Herbert Chase is the author of "Die Castings," a treatise on their design, composition, application, specification, testing and finishing. The book has just been published by John Wiley & Sons, Inc., of New York and London.

Herbert Chase

J. R. Van Dyke is engineer in charge of design for the Federal Emergency Relief Administration in North Dakota. He was an instructor in mechanical engineering at the North Dakota State College, Fargo.

C. C. Hanch, former secretary and general manager of the National Association of Finance Companies, has opened an office at 1400 Lake Shore Drive, Chicago, from which he will function as an automotive counsel.

Clay Anderson has joined the Bond Electric Corp., Jersey City, N. J.

Joseph Geschelin, engineering editor, *Automotive Industries,* is scheduled to read a paper on "The Economic Status of the Automotive Diesel Engine in Modern Transportation" at the Annual Convention of the American Petroleum Institute at Dallas, Texas, Nov. 14. Mr. Geschelin will also present a paper before the machine shop practice division of the American Society of Mechanical Engineers at the Annual Meeting of that Society in December. This paper will be concerned with "Current Practice in Surface Broaching," a subject on which Mr. Geschelin gave a paper at the last Annual Meeting of the S.A.E.

Max F. Wollering has resigned as factory manager of the Hudson Motor Car Co., Detroit.

I. Robb Walt is taking graduate work at Stanford University, Stanford, Calif.

Deaths Reported

Major Frederic Strickland, a foreign member of the Society since 1927; at Boynton Hall, Bridlington, Yorkshire, England.

Otto C. E. P. Wawrziniok, professor and director of the Institut fur Kraftfahrwesen of the technical school at Dresden, Germany. Professor Wawrziniok had been a foreign member of the Society since 1926.

Frank D. Heath, late district sales representative in Detroit for the Jones & Laughlin Steel Corp.; an associate member of the Society since 1916.

Phelps Brown, a member of the Society since 1918; late president and general manager of the Wico Electric Co., Springfield, Mass.

Charles E. Sargent

Charles E. Sargent, a celebrated large-engine designer and a very active member of the Society in the period from 1913 to 1926, died Sept. 22 at Indianapolis. Mr. Sargent, who was 72 years old, had been in ill health for several years, during which he practiced sporadically as a consulting engineer. During his more active period he served as chief engineer of Lyons-Atlas Co. and the Midwest Engine Co., the latter connection terminating in 1921. Other companies for which he had undertaken

C. E. Sargent

engineering design and research included the Wisconsin Engine Co., the American Rotary Valve Co., the Sherman Corp., and the Westinghouse Electric and Manufacturing Co. During his early years Mr. Sargent specialized in the development of steam and gas engines, many of which are still in use in municipal lighting service, etc. For his work in the development of a tandem 4-cycle double acting gas engine said to be the first ever constructed, he received in 1907 the John Scott Legacy Premium and Medal of the City of Philadelphia. This award was made after an exhaustive study of the engine by a special sub-committee of the Franklin Institute. Mr. Sargent's engine was of extremely high thermal efficiency, the products of combustion being expanded to nearly atmospheric pressure. For his work in this connection Mr. Sargent received later the Octave Chanute Memorial Medal of the Western Society of Engineers.

More than 70 patents had been developed by Mr. Sargent during his lifetime. He graduated from the University of Illinois and in 1915 received the professional degree in mechanical engineering from the same institution. Besides being a member of the Society of Automotive Engineers, he was affiliated with the Franklin Institute of Pennsylvania and the American Society of Mechanical Engineers.

He is survived by his widow and several children including Richard B. Sargent, automotive engineer, Sun Oil Co., who is also a member of the S.A.E.

Calvin W. Rice

Dr. Calvin Winsor Rice, since 1906 executive secretary of the American Society of Mechanical Engineers, died Oct. 3 of a cerebral hemorrhage.

Meetings Calendar

S.A.E. Annual Dinner

Commodore Hotel, New York, Jan. 7, 1935.

S.A.E. Annual Meeting

Book-Cadillac Hotel, Detroit, Mich., Jan. 14-18, 1935.

Baltimore—Nov. 1

Engineers' Club of Baltimore; dinner 6:30 P.M.

The Evolution of Streamlining of the Automobile; Its Development and Future Possibilities—R. H. Heald, Aerodynamic Division of the National Bureau of Standards.

Canadian—Nov. 21

Royal York Hotel, Toronto; dinner 7:00 P.M.

Engineering Research—Dr. H. B. Speakman, Ontario Research Foundation.

Chicago—Nov. 7

Oliver Hotel, South Bend, Ind.; dinner 6:30 P.M.

Recent Developments in Motor Oils—Robert E. Wilson, vice-president and director of research, Standard Oil Co. of Indiana. The regular November meeting of the Chicago Section was advanced to Oct. 23 and was featured as "Ladies' Night." H. T. Strong, of William Wiese & Co., addressed the meeting on the subject of Color Vision.

Cleveland—Nov. 13

Cleveland Club; dinner 6:30 P.M.

Dayton—Nov. 6

National Cash Register School House; dinner 6:30 P.M.

Stratosphere Flights — Captain Stevens, Wright Field.

Detroit—Nov. 5

Book-Cadillac Hotel; dinner 6:30 P.M.

The Army Alaskan Flight—Major Royce, Commandant, Selfridge Field.

Design of a High Speed Engine—Stanwood W. Sparrow, research engineer, Studebaker Corp.

Indiana—Nov. 8

The Athenaeum, Indianapolis; dinner 6:30 P.M.

Automatic-Over-Drive Developments—W. B. Barnes, Barnes Development Co., and S. O. White, chief engineer, Warner Gear Co. Observation of Over-Drives on A.A.A. Tests—Lee Oldfield, consultant.

Kansas City—Nov. 2

Steuben Club; dinner 6:30 P.M.

Subject—Transportation.

Metropolitan—Nov. 8, 9 and 10

Douglas Hotel, Newark, N. J.

Regional meeting sponsored jointly by the Metropolitan Section, S.A.E., the New Jersey Motor Truck Association, and the Newark Chamber of Commerce.

Milwaukee—Nov. 7

New England—Nov. 12

Walker Memorial, Cambridge, Mass.; dinner 6:30 P.M.

Northern California—Nov. 13

Engineers Club, San Francisco; dinner 6:30 P.M.

Modern Methods of De-asphaltizing, Dewaxing and Solvent Refining of Motor Oils —E. W. Hutton, manager lubricating oil sales, Union Oil Co. of Los Angeles. Lubricants and Lubrication for the Modern Motor Car—F. L. Wagar, manager automotive oil sales, Associated Oil Co.

Northwest—Nov. 9

Automotive Air Brakes—R. K. Whittelsey, Westinghouse Pacific Coast Brake Co.

Oregon—Nov. 9

Congress Hotel, Portland; dinner 6:30 P.M.

Social meeting and dance, with after-dinner speaker.

Philadelphia—Nov. 14

Inquirer Bldg.; dinner 6:30 P.M.

Pittsburgh—Nov. 6

Pittsburgh Athletic Association; dinner 6:30 P.M.

Behind the Scenes on the Speedways—Lee Oldfield, consultant.

Southern California—Nov. 9

Richfield Bldg. Cafeteria, Los Angeles; dinner 6:30 P.M.

Racing Car Development—Frank R. Elliott, field engineer, Ethyl Gasoline Corp.

Washington—Nov. 7

University Club, Washington, D. C.; dinner 6:30 P.M.

Some Steps in Automotive Development—Frank Taylor, Curator of Engineering, Smithsonian Institution.

Behind the Scenes With

Spark Plugs

AT various times the Society has adopted specifications for aircraft spark plugs, the 18 millimeter metric plug, the standard ⅞-18 size and standard types and dimensions for spark plugs. With the more recent developments in use, the 14-millimeter plugs, and other changes that have taken place in more recent practice, the urgency for a thorough review and modernization of the S.A.E. spark plug specification has been recognized by the Standards Committee. A special subdivision has been appointed to bring the specifications clearly up-to-date; if possible in time for adoption by the Society during the Annual Meeting next January. One of the most important phases of this study will be to bring the threaded portions of the spark plugs and their tapped holes into accord with standard screw-thread specifications.

C.F.R. Film of Road Tests

A MOTION-PICTURE story of the 1934 C.F.R. Detonation Road Tests, made at Uniontown during the progress of the work there, has been released by the Cooperative Fuel Research Committee. The film is in three reels and requires about 40 minutes showing time.

The secretary of the Committee has been authorized to lend the film to organizations wishing to borrow it, giving preference in the following order:

1. To sponsor bodies of the C.F.R. Committee.
2. To members of the C.F.R. Committee, the Detonation Subcommittee, or participants in the Uniontown tests.
3. To the general public.

Application for the film should be made to the secretary, C. B. Veal, research manager, S.A.E. Headquarters, New York City.

The film is also being released in England and France by the foreign cooperating groups.

Jig Bushings

SEVERAL years ago the Society accepted joint sponsorship, with the American Society of Mechanical Engineers and the National Machine Tool Builders' Association, of a Sectional Committee under the procedure of the American Standards Association to formulate an American Standard, for small tools and machine tool elements. Eighteen technical committees, each assigned a definite project have been working on this program. Technical Committee No. 8 (on Jig Bushings) has completed its report and the report has been approved by the general Sectional Committee and submitted to the sponsors for their approval.

As all such projects when submitted to the Society follow the same procedure as regular S.A.E. projects, this report (which will be identified as American Standard, A.S.A.-B5.6-1934) has been referred to the Production Division of the Standards Committee for review and recommendation. The division's report when completed will be submitted to the general Standards Committee and Council for S.A.E. approval as American Standard. When similar approval has been given the report by the other sponsors, it will be finally acted on by the Standards Council of the A.S.A. for publication and release as American Standard.

The report embodies nomenclature and introductory notes relative to the bushings and tabulates the detailed dimensions of headless and head types of press fit wearing bushings; the slip and plain types of renewable wearing bushings; and the headless and head types of liner bushings.

Information on Winter Oils

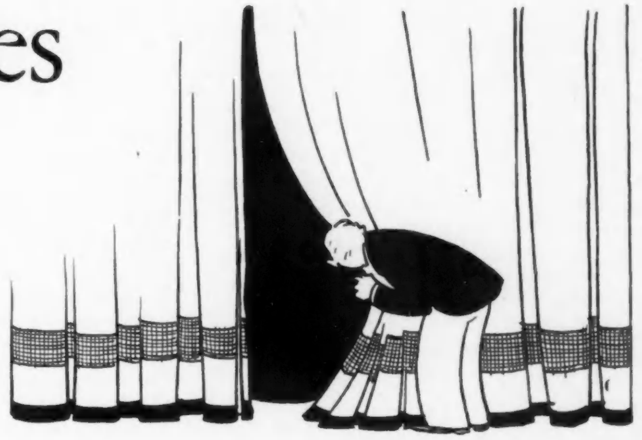
IN order to further the use of 10-W and 20-W crankcase oils during the coming winter, to remedy the difficulties experienced last year in cold-weather starting, the Lubricants Division of the Standards Committee has prepared a publicity program consisting of a number of releases to bring out facts in connection with the use of these oils for the benefit of the car drivers throughout the country.

These releases have been sent to the various trade publications in the petroleum and automotive industries as well as to a large group of daily papers. The car manufacturers are supplying their dealers with full information on the use of these oils and the petroleum companies are placing the information in the hands of their service and gasoline-filling stations in suitable form for handing it on to the car drivers.

Many refiners and marketers of petroleum products and several motor-vehicle manufacturers are cooperating heartily in disseminating desirable information about the use of 10-W and 20-W crankcase oil. In this connection one of the most interesting brochures to come to the attention of the JOURNAL has been a joint publication by L. K. Marshall, general parts and service manager, Pontiac Motor Co., and C. W. Jacobs, general parts and service manager, Buick Motor Co. The booklet is titled "The Trend is Toward Lighter Oils." It presents in attractive form necessary servicing information for winter operation of cars with emphasis on the new S.A.E. specification lubricants.

Work is progressing on the preparation of a chassis lubricants classification and a subdivision of the Lubricants Division is also reviewing the classification of axle and gear lubricants with the purpose of bringing it up-to-date and providing for this class of lubricants to be used in extremely low temperatures.

the Committees



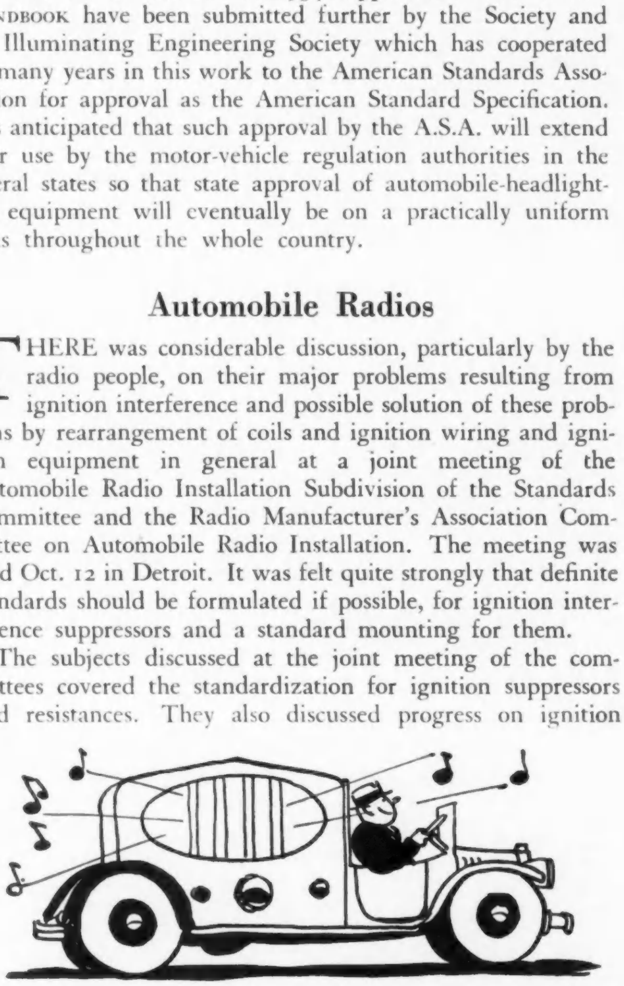
Laboratory Tests for Automobile Headlights

THE revised S.A.E. Standard Specifications for the laboratory tests of automobile headlights that was issued to the members in the 1934 supplement to the S.A.E. HANDBOOK have been submitted further by the Society and the Illuminating Engineering Society which has cooperated for many years in this work to the American Standards Association for approval as the American Standard Specification. It is anticipated that such approval by the A.S.A. will extend their use by the motor-vehicle regulation authorities in the several states so that state approval of automobile-headlighting equipment will eventually be on a practically uniform basis throughout the whole country.

Automobile Radios

THERE was considerable discussion, particularly by the radio people, on their major problems resulting from ignition interference and possible solution of these problems by rearrangement of coils and ignition wiring and ignition equipment in general at a joint meeting of the Automobile Radio Installation Subdivision of the Standards Committee and the Radio Manufacturer's Association Committee on Automobile Radio Installation. The meeting was held Oct. 12 in Detroit. It was felt quite strongly that definite standards should be formulated if possible, for ignition interference suppressors and a standard mounting for them.

The subjects discussed at the joint meeting of the committees covered the standardization for ignition suppressors and resistances. They also discussed progress on ignition



suppression without spark plug resistance. One apparently rather serious problem that is coming up is in connection with antennae, design and location in cars with all steel roofs. Another point discussed was the possibility of all car manufacturers adhering to the practice of grounding the positive side of the electrical system in cars so that radio equipment will not have to be made for both positive and negative grounding practice. A survey has indicated that the majority of car manufacturers are grounding the positive side, but as yet this practice is not universal. A very interesting discussion of the generation of static charges on cars, and effect on radio operation took place.

During the annual fall meeting of the Institute of Radio Engineers they will hold a joint technical session with the Radio Manufacturers Association. At the morning session on Wednesday, Nov. 14, the topic will be "Desirability of Reduction of Radio Interference" from the viewpoint of the customer, the public utilities, the radio manufacturers, the dealer and the communications commission.

A report on investigation and suppression of inductive interference will be presented by the radio branch of the department of Marine which has supervision over all Canadian radio operation. During the afternoon there will be general discussion by interested organizations on promotion of interference reduction, at which time Robert Stinson, Chrysler Corp., and Ray Ellis, United Motors Service, will discuss this subject informally on behalf of the S.A.E. committee, from the automotive engineer's point of view.

The three-day meeting will be at the Sagamore Hotel, at Rochester, New York.

Reflex Reflectors

ONE of the more important accomplishments this year in connection with automobile lighting problems has been the issuing of the revised specification for reflex reflectors in the August, 1934, supplement to the S.A.E. HANDBOOK. A number of states have enacted legislation requiring the use of such reflectors on motor-trucks operating within those states. The new specifications, which it is understood are now in use by several states, will relate to the types of reflectors that are incorporated in rear-lamp assemblies as well as those that are used separately.

Iron and Steel Compositions

THE Iron and Steel Division held its third meeting on Sept. 17 in Detroit and has practically completed its revision of the steel compositions. The revised notes of carburizing and heat-treating practice have been drafted for final review by the Division and a comparative table of hardness numbers has been submitted by the subdivision for the Division's review and approval. It is expected that the next meeting of the Division will be held the latter part of November to act finally on the work that has been done so far, after which the entire Iron and Steel Specifications as revised and including general notes and instructions on the specifications and their use will be prepared by the editing committee for submission to the general Standards Committee and Council of the Society for final approval at the Annual Meeting next January.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Sept. 10, 1934, and Oct. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

ADAMSON, N. FREDERIC (M) assistant chief engineer, Twin Disc Clutch Co., 1328 Racine Street, Racine, Wis.

BEATTY, JOHN T (A) president, treasurer, United Air Cleaner Co., 9705 Cottage Grove Avenue, Chicago.

BURROUGHS, KENNETH L. (J) instructor in aeronautics, Aeronautic University, Inc., 1338 South Michigan Avenue, Chicago (mail) 819 Linden Avenue, Oak Park, Ill.

CAMPBELL, KENNETH (M) test engineer, Wright Aeronautical Corp., Paterson, N. J. (mail) 348 Plaza Road, Radburn, N. J.

CHITTICK, M. B. (M) assistant chief chemist, Pure Oil Company, 35 East Wacker Drive, Chicago.

COLE, CHARLES ARNOLD (A) district manager, Thompson Products, Inc., Cleveland (mail) 780 Greenwood Avenue, Birmingham, Mich.

DARBY, ROBERT ALAN (J) graduate student, Massachusetts Institute of Technology, Cambridge, Mass. (mail) 220 East High Street, Somerville, N. J.

EATON, BRUCE G., JR. (J) engineer, Curtiss Aeroplane & Motor Co., Buffalo, N. Y.

HARRIS, W. ERIC (A) manager, Electric Auto-Lite, Ltd., Sarnia, Ontario, Canada.

JACKSON, RICHARD W. (J) experimental engineer, Hudson Motor Car Co., Detroit (mail) 434 Grosse Pointe Blvd., Grosse Pointe, Mich.

PERRILL, HARLAN KNOX, Lt. j.g. (J) naval aviator, U. S. Navy, Headquarters R.O.T.C., University of Michigan, Ann Arbor, Mich.

REED, M. J. (M) secretary treasurer, Diesel Engine Manufacturers Assn., 2 West 45th Street, New York City.

REINHARDT, W. L. (M) chief engineer, Willard Storage Battery Co., 246 East 131st Street, Cleveland.

SNYDER, CLIFFORD L. (M) sales engineer, L. A. Young Spring & Wire Corp., 9200 Russell Street, Detroit (mail) 1634 Atkinson Avenue.

STRYKER, CLINTON E. (M) chief engineer, Fansteel Products Co., Inc., North Chicago, Ill.

THORP, GEORGE BOULTON (M) instructor, aeronautical engines, Carnegie Institute of Technology, Pittsburgh, Pa.

WALTON, ARTHUR LEE (J) assistant modeler, Solar Aircraft Co., 1212 West Juniper Street, San Diego, Calif. (mail) 3030 Locust Street.

WILDER, AUSTIN B. (M) automotive engineer, Pure Oil Co., 35 East Wacker Drive, Chicago (mail) 477 Oakdale Avenue, Hubbard Woods, Ill.

Applications Received

The applications for membership received between Sept. 15, 1934, and Oct. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

AKERMAN, JOSEPH REID, mechanic, Walker-Durant Motor Co., Augusta, Ga.

ANDERSON, JAMES WALKER, JR., sales manager, Monarch Governor Co., Detroit.

BASS, ERNEST LEON, chief engineer, aviation department, Asiatic Petroleum Co., London, E. C. 2, England.

CATALANO, WILLIAM A., sales engineer, The Standard Oil Co. of Ohio, Cleveland.

CLEAVER, GEORGE H., superintendent, American Stores Co., Philadelphia.

COHEN, SAMUEL J., president, American Chemical Products Co., Rochester, N. Y.

DIVELY, CLYDE A., research laboratory assistant, White Motor Co., Cleveland.

DUNHAM, ROBERT E., research engineer, Hyvis Oils, Inc., Warren, Pa.

ELFES, DONALD B., test inspector, Packard Motor Car Co., Detroit.

GIBBONS, THOMAS, sales promotion, Ford Motor Co. of Canada, Ltd., Walkerville, Ont., Canada.

HUNTING, HERBERT, assistant engineer, W. T. Fishleigh, Detroit.

KAY, TORRENCE D., chemist, United Petroleum Corp., Omaha, Nebr.

LITTELL, ROBERT E., draftsman, Material Division, U. S. Army Air Corps, Wright Field, Dayton, Ohio.

MACMILLAN, HARRY L., sales manager, National Motor Bearing Co., Oakland, Cal.

MOLNAR, ERNEST, 245 Barthman Avenue, Columbus, Ohio.

MORI, TARO, designer, Tokyo Gas & Electric Engineering Co. Ltd., Tokyo, Japan.

MORRISON, JOHN W., assistant engineer, The Cleveland Tire Spring Co., Cleveland.

OLANDER, ALDEN C., sales promotion, Studebaker Sales Corp., South Bend, Ind.

PATCHETT, GEORGE WILLIAM, chief designer, Zbrojovka Ing. F. Janecek, Prague, Czechoslovakia.

SALTER, TOM, engineer, Cessna Aircraft Co., Wichita, Kansas.

SCHROEDER, WILBUR K., Blocksom & Co., Michigan City, Ind.

SCHWEIGLER, HARRY EDWARD, student, Aeronautical University, Chicago.

TAYLOR, FRANK HOWARD, automotive engineer, The Texas Co., Camp Hill, Pa.

TUSZYNSKI, JAN AUGUST, chief fuels and lubricants section, Institute of Research for Aeronautics, Warsaw, Poland.

WEISER, JOSEPH, c/o Neill, 50 Granger Place, Buffalo, N. Y.

WOLFSOHN, ROBERT SMITH, 517 West 113th Street, New York City.

Proposed Amendments to the Constitution

To the Members:

At the Semi-Annual Meeting of the Society held at Saranac Inn, N. Y., last June, the amendments to the Constitution which are set forth herein below were presented.

In compliance with paragraph 57 of the Constitution of the Society, the proposed amendments are submitted herewith to the voting members of the Society for their consideration prior to the 1935 Annual Meeting. After discussion and final amendment at the latter meeting, the amendments will be submitted by letter ballot on adoption to all members entitled to vote, provided 20 votes in favor of such submission are cast at that meeting.

Proposed amendments of C-15, C-22, C-45, C-46, C-54 and C-57, and Proposed New C-50A

C-15

Present Constitution

C-15 All original applications for election to the grade of Member, Associate, Junior, Service Member or Foreign Member, shall be presented to the Council, which shall consider and act upon each application, electing each applicant to the grade of membership to which, in its judgment, his qualifications entitle him. Two negative votes shall defeat an election.

Proposed Addition to C-15

The Council may organize a Committee of its own selection to collect the necessary information regarding applicants for membership in the Society, and to present this information to the Council in such form as the Council may specify.

C-22

Present Constitution

C-22 Upon transfer of a Junior to Member, or Junior to Associate, such member shall pay the difference in initiation fee of the grades; and thereafter pay the annual dues for the grade to which he is transferred.

A Service Member shall upon the termination of his connection with the Service promptly notify the Secretary of such termination, shall then be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member in C-20 and the actual amount paid by the Service Member at the time he qualified, and thereafter, beginning with the next fiscal period, shall pay the annual dues for Member grade.

A Foreign Member shall notify the Secretary upon change of residence to territory rendering him ineligible for Foreign grade, or temporary change of abode to such territory for more than six months in a given fiscal period, and shall thereupon be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member in C-20 and the actual amount paid by the Foreign Member at the time he qualified, and thereafter, beginning with the next fiscal period, shall pay the annual dues for Member grade.

Proposed Amendment to the second and third paragraphs of C-22

A Service Member shall upon the termination of his connection with the Service promptly notify the Secretary of such termination, shall then be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member and that specified for Service Member at the time of transfer, and thereafter, beginning with the next period for which dues are payable, shall pay the annual dues for Member grade.

A Foreign Member shall notify the Secretary upon change of residence to territory rendering him ineligible for Foreign Member grade, or temporary change of residence for more than six months in any given fiscal year, and shall thereupon be transferred to Member grade, and shall pay the difference in initiation fee between that specified for Member and that specified for Foreign Member at the time of transfer, and thereafter, beginning with the next period for which dues are payable, shall pay the annual dues for Member grade.

C-45

Present Constitution

C-45 The President shall, within thirty days after taking office, appoint from the individual membership of the Society members of the following Annual Administrative Committees designating the chairmen and the vice-chairmen thereof, as indicated below:

Finance Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

Publication Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

House Committee (consisting of five members); five members to be appointed by the President, he designating one of these five members as chairman.

Membership Committee; five members to be appointed by the President; the chairmen of the Membership Committees of the geographical Sections and of the Professional Activities, and a representative of the Society staff to be designated by the General Manager of the Society, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and vice-chairman of the committee for the year.

Meetings Committee; five members to be appointed by the President; the chairmen of the Meetings Committees of the Professional Activities and of the geographical Sections, and a representative of the Society staff to be designated by the General Manager of the Society, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and the vice-chairman of the committee for the year.

Sections Committee; three members to be appointed by the President; the other members of the Committee consisting of one member of the Society to be elected from and by each geographical Section of the Society each year prior to the Annual Meeting of the Society. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and the vice-chairman of the committee for the year.

Constitution Committee (consisting of three members); one member to be appointed by the President each year for a term of three years, the member of the Committee who shall have but one year yet to serve being the Chairman of the Committee.

Proposed amendment to the fifth paragraph of C-45

Membership Committee; five members to be appointed by the President; the chairmen of the Membership Committees of the geographical Sections and of the Professional Activities, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and the vice-chairman of the committee for the year.

Proposed amendment to the sixth paragraph of C-45

Meetings Committee; five members to be appointed by the President; the chairmen of the Meetings Committees of the Professional Activities and of the geographical Sections, to be members of the Committee. The committee members so appointed and designated shall serve for one year, during the administrative year. From these members the President shall name the chairman and vice-chairman of the committee for the year.

C-46

Present Constitution

C-46 The Annual Nominating Committee of the Society shall consist of one Member of the Society to be elected from and by each geographical Section of the Society prior to the Annual Meeting; and three Members of the Society who shall be elected at the Business Session of the Annual Meeting preceding the Annual Meeting at which officers are to be elected; no two of said three Members shall reside in the same Section district. The work and procedure of the Committee shall be as defined in the By-Laws.

Proposed Amendment

C-46 The Annual Nominating Committee of the Society shall consist of three delegates at large, and one delegate from each geographical Section of the Society. No two of the delegates at large shall reside in the same Section district. The delegates at large shall be elected by the Members present at the Business Session of the Annual Meeting. The Section delegates shall each be Members elected by and from each Section prior to the Annual Meeting of the Society. Each Section may elect in addition to a delegate, a first alternate and a second alternate. The first alternate shall serve in the absence of the delegate, and the second alternate shall serve in the absence of both the delegate and the first alternate. Neither a delegate nor an alternate may be represented by a proxy at a meeting of the Nominating Committee. The work and procedure of the Committee shall be as defined in the By-Laws.

Paragraph to be added to the Constitution

C-50A The Past-Presidents of the Society shall constitute the Advisory Committee. This Committee shall meet once during the Annual Meeting and at such other times and places as it may elect. This Committee shall provide for its own organization. The Committee may consider any matter referred to it by the Council, or any other matter which in its opinion concerns the interests of the Society. The Committee may report its recommendations directly to the Council, or directly to the membership of the Society when such recommendations have the approval of a majority of its full membership.

C-54

Present Constitution

C-54 The Society shall claim no exclusive copyright to any papers read at its meetings, or any reports or discussions thereon. The policy of the Society shall be to give the papers read before and reports adopted at its meetings wide circulation, with a view to making the work of the Society known, encouraging engineering progress, fulfilling the Society's object and extending the professional reputation of its members.

Proposed Amendment

C-54 The Society shall claim no exclusive copyright to any paper read at its meetings, or any discussions thereon. The policy of the Society shall be to give the papers read before and reports adopted at its meetings wide circulation, with a view to making the work of the Society known, encouraging engineering progress, fulfilling the Society's object and extending the professional reputation of its members.

C-57

Present Constitution

C-57 At any Annual or Semi-Annual Meeting of the Society any voting member may propose in writing an amendment to this Constitution. Such proposed amendment shall not be voted on at that meeting, but, if duly seconded by a voting member, shall be open to discussion and to such modification as may be accepted. The proposed amendment shall be mailed by the Secretary to each member of the Society entitled to vote, at least sixty days previous to the next Annual or Semi-Annual Meeting, accompanied by comment of the Council, if it so elects. At that Annual or Semi-Annual Meeting such proposed amendment shall be presented for discussion and final amendment, and shall subsequently be submitted by letter ballot to all members entitled to vote, provided that 20 votes are cast in favor of such submission. The letter ballot, accompanied by the text of the proposed amendment, shall be mailed by the Secretary to each member of the Society entitled to vote, promptly after the close of the said meeting. Thirty days after the date on which the ballots are mailed to the voting membership, the ballots returned shall be counted by Tellers appointed as provided in the By-Laws. The Tellers shall announce immediately the result of the vote which shall be mailed to the members by the Secretary. The adoption of the amendment shall be decided by a majority of the votes cast.

An amendment shall take effect immediately upon the announcement of its adoption.

Proposed Amendment

C-57 Amend by inserting the following for the first sentence, the remainder of C-57 to be unchanged:

At any Annual or Semi-Annual Meeting of the Society any properly authorized voting member may propose in writing an amendment to this Constitution. Any member may secure authorization to propose an amendment by securing the signatures of twenty voting members to a petition in which the proposed amendment is set forth, or by a majority vote of the Constitution Committee, or by a majority vote of the Council, which may be obtained at any regular meeting of the Council or by letter ballot at the request of the President.

These proposed amendments have been approved by the Constitution Committee and Council of the Society.

Society of Automotive Engineers
John A. C. Warner, Secretary.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

Stalling

By B. Melvill Jones. Published in *The Journal of The Royal Aeronautical Society*, September, 1934, p. 753. [A-1]

The author has chosen for the subject of the Twenty-Second Wilbur Wright Memorial Lecture, "Stalling," which he has on two previous occasions discussed before the Royal Aeronautical Society.

Professor Jones points out that the problem is by no means solved, that unslotted airplanes have been found to vary from types which were so dangerous that they could not be put into service to types upon which accidents due to inadvertent stalling are very rare, and even among airplanes with slotted wings and obviously adequate rudders considerable differences of reputation are found between the different types, and these differences cannot always be adequately explained. It is with the experimental methods by which these differences in behavior may possibly be explained that the major part of the lecture deals.

The author explains, in closing, that he has discussed experiments which are still in an incomplete form and put forth ideas of somewhat tentative character.

The Drag of Streamline Bodies

By M. H. Lyon. Published in *Aircraft Engineering*, September, 1934, p. 233. [A-1]

The relative importance of skin friction and pressure in relation to full-scale design is set forth as the result of an experiment.

Skin Friction Correction

By L. Bairstow. Published in *Aircraft Engineering*, September, 1934, p. 245. [A-1]

A resumé of investigations into boundary-layer theory, summarizing knowledge on the subject.

Computation of the Two-Dimensional Flow in a Laminar Boundary Layer

By Hugh L. Dryden. N.A.C.A. Report No. 497, 1934; 11 pp., with tables and charts. Price, 5 cents. [A-1]

Relative Loading on Biplane Wings of Unequal Chords

By Walter S. Diehl. N.A.C.A. Report No. 501, 1934; 8 pp., with charts. Price, 5 cents. [A-1]

Complete Tank Tests of Two Flying-Boat Hulls With Pointed Steps—N.A.C.A. Models 22-A and 35

By James M. Shoemaker and Joe W. Bell. N.A.C.A. Technical Note No. 504, September, 1934; 21 pp., 35 figs. [A-1]

Evaluation et Contrôle des Altitudes en Vue des Records

By Pierre Berger. Published in *L'Aéronautique*, August, 1934, Aérotechnique section, p. 65. [A-1]

A critical study is made of the formula for evaluating altitude used since 1920 by the Fédération Aéronautique Internationale. A comparison is made between the altitude according to the formula and the altitude actually attained in several cases and an account given of research carried out with the object of determining the best method for evaluating altitude. The conclusion drawn is that better results are obtained when specific weight of air is used as a factor instead of pressure as in the formula.

(Continued on page 36)

MORE IMPORTANT THAN ANY MATERIAL THING

MORE important than millions of telephones and millions of miles of wire is the fundamental policy of the Bell System. It is founded on a spirit of fair dealing with the public, with employees and with those who have invested their money in the business.

• • •

"The fact that the responsibility for such a large part of the entire telephone service of the country rests solely upon this Company and its Associated Companies also imposes on the management an unusual obligation to the public to see to it that the service shall at all times be adequate, dependable and satisfactory to the user. Obviously, the only sound policy that will meet these obligations is to continue to furnish the best possible telephone service at the lowest cost consistent with financial safety. This policy is bound to succeed in the long run and there is no justification for acting otherwise than for the long run. . . .

"Earnings must be sufficient to assure the best possible telephone service at all times and to assure the continued financial integrity of the business. Earnings that are less than adequate must result in telephone service that is something less than the best possible. . . . The margin of safety in earnings is only a small percentage of the rate charged for service, but that we may carry out our ideals and aims it is essential that this margin be kept adequate. . . . This is fundamental in the policy of the management."

Quoted paragraphs from an address by Walter S. Gifford, president of the American Telephone and Telegraph Company, at Dallas, October 20, 1927.

BELL TELEPHONE SYSTEM

NOTES AND REVIEWS

Continued

BODY

The Utilitarian Aesthetics of Automobile Body Design

By W. O. Kennington. Published in *The Institution of Automobile Engineers Journal,* October, 1934, p. 47. [B-1]

This study was published privately in 1932 and has been altered very slightly to its present form.

Apart, therefore, from representing the author's opinion on the subject, it may be regarded to some degree as a forecast made at the time and based upon the philosophy outlined therein.

The reader therefore has an opportunity to prove to some extent the rightness of the arguments outlined and, if they prove correct, may use the same for other or more distant forecasting.

The illustrations of models and a number of the drawings are intended to indicate a future trend in automobile body design which is believed to be inevitable because it is the outcome of the application of laws of design which are referred to in this paper.

CHASSIS PARTS

The Problem of Variable Transmission with Special Reference to Hydraulic Types

By Jesse Bedford. Published in *The Institution of Automobile Engineers Journal,* October, 1934, p. 10. [C-1]

The main object of this paper is to set out the problem of the variable transmission and thence analyze and reduce it to a logical issue. The author points out that much valuable work has been done in the past, under conditions, however, not comparable with those of the present day, and purely historical matter is consequently excluded.

Gyroscopic Torques Not Negligible in Unequal-Length Transverse-Link Independent Suspensions

By Boris P. Sergayeff. Published in *Automotive Industries,* Sept. 29, 1934, p. 330. [C-1]

By analysis the author shows that the gyroscopic torques resulting in forces on the steering arms and links are not so small as to be negligible.

Die Messung der Beanspruchungen und Schwingungen in Kraftwagenfahrgestellen

By Walther Saran. Published in *Automobiltechnische Zeitschrift,* July 25, 1934, p. 363. [C-1]

Using an instrument developed by the German Institute for Aeronautical Research, the author determined the stresses in the front axle and side frame members of a car under various running conditions. The instrument measures and graphically records the deformation due to stress and vibration, and from these diagrams the severity of stress and the frequency with which it changes direction may be determined.

Etude des Mouvements de Galop des Voitures

By G. Broulhiet. Published in *Journal de la Société des Ingénieurs de l'Automobile,* June-July, 1934, p. 2789. [C-1]

Streamlining of cars brings up new problems affecting mass distribution, together with its natural effect on suspension, particularly in connection with the phenomenon known as gallop. The author first studies the effect on stability of streamlining, treating the importance of mass distribution, rear versus front engine mounting and optimum wheelbase. Minimizing the effect of gallop by placing the shock absorber in such a location as to increase the periods and decrease the acceleration of the oscillations due to it is then advised. A gyroscopic stabilizer is suggested for this purpose.

ENGINES

Energy Distribution in the Internal Combustion Engine

By L. C. Lichty. Published in *Automotive Industries,* Sept. 22, 1934, p. 354. [E-1]

The writer cites a typical published example of how misleading a conclusion can be when based upon the common erroneous method of including friction loss in the subject of heat balance, and shows in this paper that friction loss is included in the three losses termed exhaust, cooling system and radiation losses.

Combustion Chamber Design in High Speed Compression-Ignition Engines

By Percival Biggar. Published in *Automotive Industries,* Sept. 29, 1934, p. 384. [E-1]

A critical appraisal and comparison of the various types in current use.

(Continued on page 38)

NOTES AND REVIEWS

Continued

Effect of Moderate Air Flow on the Distribution of Fuel Sprays After Injection Cut-Off

By A. M. Rothrock and R. C. Spencer. N.A.C.A. Report No. 483, 1934; 23 pp., illustrated. Price, 10 cents. [E-1]

Infrared Radiation from Explosions in a Spark-Ignition Engine

By Charles F. Marvin, Jr., Frank R. Caldwell and Sydney Steele. N.A.C.A. Report No. 486, 1934; 14 pp., with charts. Price, 10 cents. [E-1]

Further Experiments on Cylinder Wear Carried Out Under the Direction of the I.A.E. Research and Standardization Committee

Prepared by C. G. Williams. Published in *The Institution of Automobile Engineers Journal,* August-September, 1934, p. 19. [E-1]

The report begins by discussing the possible causes of corrosion at low temperatures, and experiments are described in which attempts were made to operate an engine on a nitrogen-free atmosphere. The results obtained in these experiments suggested that carbonic acid, resulting from the solution of CO_2 in water, was a possible cause of corrosion, and further experiments using hydrogen fuel and various motoring tests confirmed this hypothesis. The solubility of CO_2 in water increases with pressure, with the result that "wear" at low temperatures increases with load. Tests carried out on fuels of various sulphur content indicated that sulphur contents of the order of 0.1 per cent, have a marked effect in accelerating "wear." An alcohol blend gave greater wear than petrol at low temperatures, therefore emphasizing the necessity for rapid warming-up with such fuels; this higher wear is attributed to the action of organic acids. No difference in wear between petrol and the alcohol blend was observed at normal operating temperatures.

Motoring tests are being carried out to investigate wear at high temperatures.

Experiments are described which indicate that the field for upper cylinder lubrication is in connection with starting from cold. Stopping and starting tests on a new engine showed a large reduction in wear by the injection of "doses" of lubricant into the intake at each start.

Zur Physik der Brennstoffstrahlen in Dieselmaschinen

By Hans Mehlig. Published in *Automobiltechnische Zeitschrift,* August 25, 1934, p. 411. [E-1]

This, the leading article in an issue devoted to Diesel engines, treats of the physics of fuel spray injection. The effect on penetration of back pressure, nozzle diameter and injection pressure is treated theoretically. In dealing with atomization results of tests are cited to prove that the diameter of fuel drops in a spray does not vary under greatly varying fuel injection conditions, but that air turbulence has a significant influence.

Other articles deal with the characteristics of pre-combustion chamber operation, bearing loads of Diesel engines, and design features of various automotive Diesels.

Die Liefergrad Schnellaufender Viertakt-Vergasermotoren

By Ernst Drucker. Published in *Automobiltechnische Zeitschrift,* July 25, 1934, p. 359. [E-1]

In a theoretical discussion of the volumetric efficiency of high-speed four-stroke cycle carbureter engines, the author analyzes the effect of valve diameter, compression ratio, cylinder capacity, exhaust gas temperature and exhaust back pressure.

MATERIAL

Mechanism of Gum Formation in Cracked Gasoline—Formation of Peroxide, Aldehyde, and Acid in Storage

By C. G. Dryer, C. D. Lowry, Jr., J. C. Morrel, and Gustav Egloff. Published in *Industrial and Engineering Chemistry,* August, 1934, p. 885. [G-1]

Earlier work has shown that peroxide, aldehyde, and acid can be detected in cracked gasoline as it deteriorates and forms gum. In this study the rate of formation of substances of these four classes has been followed in gasolines of several origins. Some were unrefined, some refined, and some contained inhibitors. The deterioration has been studied during storage for a year.

Gum begins to appear in rather large amount as soon as considerable peroxide has formed and before any large development of aldehyde or acid. The curve of gum content vs. time is similar in shape to the peroxide curve, and the authors indicate that the conclusion seems justifiable that gum formation is closely related to the concentration of peroxide, and that aldehyde and acid are products of secondary reactions rather than intermediates in gum formation.

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NOTES AND REVIEWS

Continued

Factors Affecting Lubricating Properties of a Petroleum Oil

By F. H. Rhodes and Arthur W. Lewis. Published in *Industrial and Engineering Chemistry,* September, 1934, p. 1011. [G-1]

The investigation described in this paper was undertaken for a twofold purpose: (1) to isolate and to identify the component that is primarily responsible for the "oiliness" of petroleum lubricants; and (2) to discover, if possible, other substances that, when added to an oil, will have a similar effect in improving the lubricating properties. The first of these problems, the authors state, has not yet been solved; the second objective has been obtained.

The article sets forth that the effects of a petroleum lubricant in reducing the static coefficient of friction in a bearing appears to be due primarily to the presence of a small amount of some substance that is firmly adsorbed on the surface of the bearing to form a film of high lubricating power. This film does not form instantly on a freshly oiled surface; an appreciable length of time elapses before equilibrium is established.

The constituent that is primarily responsible for the lubricating power may be removed from the oil by adsorption on finely divided metal—for example, on powdered Wood's metal. It is retained so tenaciously by the metal that attempts to recover it in a relatively pure form have not been successful.

The authors point out that when a petroleum lubricant is heated in the presence of air, a marked loss of lubricating power occurs at about 75°C. This change appears to be the result of oxidation. It may be inhibited by adding small amounts of certain substances to the oil. Cyclohexanol and B-naphthol are among the addition agents that show this effect. These particular addition agents also improve the lubricating power of the oil at ordinary temperatures.

Gases from Cracking Hydrocarbon Oils

By Gustav Egloff and J. C. Morrell. Published in *Industrial and Engineering Chemistry,* September, 1934, p. 940. [G-1]

The object of the work was to study the cracking of various oils, particularly from the viewpoint of gas formation and its composition, especially when producing commercial yields of gasoline.

Cracking tests were made on various stocks including gasoline, naphtha, and kerosene from Midcontinent crude oils; kerosene distillate, a mixture of heavy naphtha and light gas oil, and gas oils from California crude oils; topped crude oils from Midcontinent and Somerset crudes and Mt. Pleasant and Refugio (Texas) crude oils. The operating pressures of these runs varied from 250 to 750 lbs. per sq. in. (17.57 to 52.73 kg. per sq. cm.) and the temperature from 875° to 970°F. (468° to 524°C.)

The apparatus employed in carrying out the tests is described and the operating conditions and yields of products from the various runs are summarized in table form.

The authors point out that the following groups of compounds have been synthesized and produced commercially from cracked gases: alcohols, amines, chlorides, glycols, nitroglycols, chlorohydrins, ethers, ketones, acids, and esters. Some of the outstanding uses for these products are as antifreeze agents (ethylene glycol), explosives (nitroglycols), agents to remove hydrogen sulfide or carbon dioxide from gases (triethanolamine), solvents for lubricating oil treatment (dichloroethyl ether), medicinals (acetoacetanilide), fumigants (ethylene oxide), solvents for plastics and lacquers (alcohols, esters, ketones), resins, synthetic rubber, and others.

The Improvement of White Bearing Metals for Severe Service; Some General Considerations

By D. J. Macnaughtan. [G-1]

Elongation Values of Copper and Copper-Rich Alloys

By Maurice Cook and Eustace C. Larke. [G-1]

The above listed preprints of papers of interest presented at the September meeting of the Institute of Metals in Manchester, England, have come to our attention. These papers will be published in permanent form in the Journal of the Institute of Metals, Vol. LV, 1934.

Premier Rallye International sur Routes Alpestres pour Automobiles avec Carburants succédanés

Published by Österreichisches Kuratorium für Wirtschaftlichkeit, Vienna, Austria. 20 pp.; 3 illustrations. [G-1]

This pamphlet sets forth the rules and general information on the first international rally on Alpine roads for automobiles using other than gasoline as fuel. Four nations are participating in the event, designed to test the utility of such fuels under varying road conditions, particularly mountainous. About 1,500 miles will be traversed by the vehicles, which are permitted to use solid fuel in gas producers, gaseous fuel, such liquids as alcohol-blends and may also include steam and Diesel powered vehicles.

(Concluded on page 42)

NOTES AND REVIEWS

Concluded

MISCELLANEOUS

Mechanical Vibrations

By J. P. Den Hartog. Published by McGraw-Hill Book Co., New York City, 1934; 390 pp. [H-1]

This book has been developed from lectures which were first presented to the Design School of the Westinghouse Company in East Pittsburgh, Pa. Since 1932 the author has given a regular course in the subject for seniors and first-year graduate students at the Harvard Engineering School. The author explains that in preparing these lectures in book form the material was extended somewhat by including as illustrations a number of cases of vibration trouble that have occurred in the experience of the author and of his friends, and the material has been brought up to date by a discussion of some of the more important contributions of the recent literature.

The book is written to meet the needs of the practicing engineer as well as the requirements of class instruction. All important results are given in graph form and the topics discussed are limited to those which have proved to be of genuine practical interest. A fairly complete set of references is relegated to the end of the book to avoid footnotes.

PASSENGER CAR

Quelques Réflexions, avant le Salon, sur l'Achat d'une Voiture

By A. Caputo. Published in Omnia, September, 1934, p. 125. [L-1]

Anticipating the developments to be looked for at the coming Salon, the author comments on certain features in which distinct progress is to be expected: among others, independent front-wheel suspension, front-wheel drive, rigid chassis, four-speed gearboxes, automatic transmissions, free-wheeling and streamlining.

Quelques Considérations Techniques sur le Grand Prix de L'A.C.F. 1934

By A. Caputo. Published in Omnia, August, 1934, p. 82. [L-1]

Particular emphasis is laid, in these technical comments on the results of the 1934 Grand Prix, on the German entries, which were financed by popular subscription, and on those of Italy, supported, in accordance with governmental orders, by the banks. An account is given of the race, with comments on the design features of the entries and on the application to the passenger-car of lessons learned on the race-track.

Papers Available in Mimeographed Form

UNTIL current supplies are exhausted, copies of the papers listed are available in mimeographed form at a cost of 25 cents per copy to members; and at 50 cents per copy to non-members. Orders should specify the name of the author as well as the title of the paper desired.

Orders must be accompanied by remittance and should be addressed to Sessions Secretary, Society of Automotive Engineers, 29 West 39th St., New York, N. Y.

Barish, Thomas
Bearings for Controllable Propellers

Bleicher, C. E.
Relative Merits of Precision Manufacturing and Correct Plant Layout to Accomplish Cost, Quality and Uniformity of Parts Production

Brettell, Clinton
How Economies in Motor Vehicle Operation Can Be Effected from an Operator's Standpoint

Briggs, Commander W., and Fox, M. L.
Body Noise

Britton, Roy F.
Taxation and Regulation as Applied to Highway Transportation

Brown, Lowell H., and Herbert Chase
Streamlining—Up-to-date Facts and Developments

Brown, W. C., and Roper, V. J.
The Well-Lighted Car

Bull, A. W.
Tire Noise

Chandler, F. F.
Notes on Steering

Clinton, G. E.
Problems of Industry in Using the Highways

DeSmet, E. C.
Planography—The New Science of Surface Design

Drake, H. W.
Problems of the Fleet Operator

Fitzsimmons, J. T.
Problems and Tendencies in Electrical Equipment

Foley, Hamilton
The Manufacture and Magnetic Testing of Hollow Steel Propellers

Foster, A. L.
Prospects for Future Diesel Fuels, and Their Available Supply

Friend, W. Z. and Beckwith, E. Q.
Propane and Butane as Motor Fuels

Froesch, Charles
Some Aspects of Commercial Aviation

Frye, Jack
New Airline Advancements: Maintenance and Operations

Geniesse, J. C.
Fuel and Oil Economy for the Operator

Geschelin, J.
Trends and Future Developments in Motor Truck Design

Haarz, W. G., Jr.
Beauty Sells Cars in 1934

Hardy, F. I.
Economic Application of Rates for Movement of Freight by Motor Trucks

Havill, C. H.
Theory and Characteristics of Eclipse Automatic Variable Pitch Propeller

Hazard, S., Jr.
Sound Absorption and Deadening

Howard, H. H.
Some Diesel Tractor Problems

Jacoby, E. R.
Practical Design Consideration of the Internal Combustion Engine Structure

Jacoby, E. R.
Spark Ignition Engines for Agricultural and Industrial Use

Johnson, W. M.
A Résumé—and Some Conclusions about Automotive Electrical Equipment

Lampton, G. T.
The Design Requirements of a Mechanical Controllable Propeller

Lansing, R. P.
Starters for Diesel Engines

Larson, C. M.
The Realm of Extreme Pressure Lubricants

Lott, E. P.
Air Transport Operations

McCormick, Fowler
The Relation of Engineering to Manufacturing and Distribution in the Farm Implement Industry

McCrory, S. H.
Research in Agricultural Engineering

Markham, H. B.
Trend in Taxation and Regulation of Highway Transportation

Mitchell, N.
High Speed Compression Ignition Engines for Passenger Vehicles or Trucks

Mock, F. C.
Utilization of Heavy Fuel With Spark Ignition

Norris, R. F.
The Automobile Motor Considered as a Sound Source

Northup, A. E.
Future Streamlining

Orr, J. M.
Accident Control in Fleet Operation

Padgett, J. E.
Machinery and Equipment Policies in View of the Present Business Situation

Peterson, C. D.
Multi-Range Transmissions

Probst, K. K.
Development of a Transverse Leaf-Spring Independent Wheel Suspension System

Shepard, E. H.
The Economy Fallacy

Sloan, W. J.
Planning and Administering Highway Systems for Greatest Usefulness

Smith, C. W.
Comparative Tests of Pneumatic Tires and Steel Wheels on Farm Tractors in Agricultural Operations

Smith, G. W., Jr.
A Technical Education

Staley, A. C.
Requirements of Tractor and Diesel Engines

Taylor, C. P.
Fitting the Highway to Traffic

Taylor, E. S.
Design Limitations of Aircraft Engines

Thee, W. C.
Standardization of Military Motor Equipment

Tinkham, G. L.
Truck Refrigeration with Propane

Tirrell, E. L.
Weight Distribution on Front and Rear Axles of Motor Truck

Treiber, O. D.
Factors in Automotive Diesel Development

Veal, C. B.
Mind or Micrometer

Wheeler, P. R.
Human Engineering

Winkler, A. H.
Service Problems and Trends in Motor Vehicle Maintenance

Wolf, A. M.
Lightness in Truck Design

Wright, T. P.
Controllable Pitch Propellers—Design Considerations

Zucrow, M. J.
Some Experiences with Heavy Fuel Equipment for Spark Ignition Engines

What Members Are Doing

*O. E. **Hunt*** (M'15), vice-president, General Motors Corp., has been elected to the board of directors of the Corporation, and so has

C. E. Wilson (M'14), also a vice-president of the Corporation.

Charles L. Lawrance, president, Lawrance Engineering and Research Corp., Linden, N. J., has requested that mail be addressed to him at 151 East 63rd St., New York City.

Dr. George W. Lewis, director of aeronautical research, National Advisory Committee for Aeronautics, was to deliver a lecture on "Recent Aviation Developments and What the Future Holds," at Swarthmore College on Nov. 17. Dr. Lewis, who was formerly professor of mechanical engineering at the College, was sponsored for the lecture by the division of engineering of the College, and the William J. Cooper Foundation, which makes special grants to the College for the purpose of lectures in modern problems.

William M. Gage, district manager in the Detroit area for the Federal Motor Truck Co., has been transferred to New York City in the company's New York Branch organization.

Fred R. Rath has returned to the Pontiac Motor Co. as tool engineer.

Vernon G. Souder, formerly sales engineer with the American Injector Co., is now a sales representative for the Chrysler Motor Parts Corp.

Rupert C. Mouat is now technical correspondent with General Motors (South African), Ltd., at Port Elizabeth, South Africa.

Robert A. Darby is in the weight department of the General Aviation Mfg. Corp., Dundalk, Md. He was recently a graduate student at the Massachusetts Institute of Technology.

Adolf P. C. Schramm, consulting engineer, has moved his office from 30 Rockefeller Plaza to 137 East 25th St., New York City.

L. M. Stellmann, formerly consulting engineer and patent attorney at Syracuse, N. Y., has been named senior mechanical engineer in the Naval Aircraft Factory, Philadelphia.

Carl J. Crane, first lieutenant, Air Corps, has been transferred from Albrook Field, Canal Zone, to Wright Field, Dayton, Ohio.

Arthur A. Howgrave, who has been acting as district traffic superintendent (roads) of H.E.H. The Nizam's State Railway, Secunderabad, India, has completed his agreement with that organization and is now managing director for Messrs. Southampton Carriers Agency, Ltd., Southampton, England. His address is c/o Grindlay & Co., 54 Parliament St., London, S.W.1.

Herman C. Morris, formerly test engineer with the National Bureau of Standards, is now factory representative at Washington, D. C., for Defiance Spark Plugs, Inc.

Charles W. Hall, president, Hall-Aluminum Aircraft Corp., announces that he has moved his headquarters to Radcliffe St., Bristol, Pa.

Garland Powell Peed, Jr., is now scientific aide at Langley Field, Va., for the National Advisory Committee for Aeronautics.

Karl M. Wise

Karl M. Wise, formerly director of engineering, Pierce-Arrow Motor Car Co., has become affiliated with the staff of the Bendix Aviation Corp. as technical advisor on special assignments. Mr. Wise also becomes vice-president in charge of engineering of the Marshall Asbestos Corp. Prior to his connection with Pierce-Arrow, Mr. Wise was executive engineer, Studebaker Corp. He has been a member of the Society since 1919, and was elected vice-chairman of the Buffalo Section for the 1934-35 term.

L. M. Klinedinst, vice-president of the Timken Roller Bearing Co., has been elected a member of the board of directors of the company and will assume direction of sales to fill the vacancy created by the resignation of

Judd W. Spray who has resigned. Mr. Spray plans to spend the Winter in Florida and to rest indefinitely before announcing his future plans.

T. V. Buckwalter, who has been vice-president of the Timken Roller Bearing Co. for several years, has been elected vice-president and director of the Timken Steel & Tube Co.

J. R. Charlton Armstrong, engineer-examiner, Federal Emergency Administration of Public Works, has been transferred from the Administration's Washington office to the office at Fort Worth, Tex.

Yrjo Leiviska, formerly a student of the judicial faculty of the State University of Finland, is now employed temporarily as auditor in the general accounting office of the government of Finland, at Helsinki, Suomi (Finland).

L. S. Hobbs **B. H. Gilpin**

whose appointments as vice-presidents of the Pratt & Whitney Aircraft Co. were announced in the last issue of the Journal

H. L. Horning, president, Waukesha Motor Co., sailed Nov. 9 for Europe, where he will confer with a number of well-known men in the internal-combustion engine field and petroleum industry. On his trip, which will last six weeks, Mr. Horning was accompanied by

J. B. Fisher, chief engineer, Waukesha Motor Co. Mr. Fisher is a councilor of the Society and Mr. Horning a past-president.

Clarence A. Reppert, formerly airplane draftsman with the General Aviation Mfg. Corp., is doing layout work and tool design for the Kreider-Reisner Aircraft Co., Hagerstown, Md.

E. J. Hergenroether, district manager in Detroit for the International Nickel Co., has moved into larger quarters in the General Motors building there.

Victor Preston, formerly vice-president and chief engineer, H. Jay Hayes Industries, Inc., is now connected with the Detroit Moulding Corp., Detroit.

H. C. McCaslin, formerly engineer with the Willys-Overland Co., has joined the automotive-engineering division of the Cities Service Oil Co., at Houston, Tex.

Franz Oberle has been transferred from the Springfield, Mass., office of the United American Bosch Corp. to their Chicago office.

Charles W. Adams has joined the Standard Carbon Co., Steubenville, Ohio, as sales engineer. He was formerly with the Speer Carbon Co. in a similar capacity.

Russell T. Howe, formerly engineer in the experimental department, Pierce-Arrow Motor Car Co., has joined the Ray Day Piston Corp., Detroit.

Samuel V. Krauthoff, first-lieutenant, field artillery, U. S. A., has returned from a tour of duty in Hawaii, and has been assigned to the 19th Field Artillery, Fort Knox, Ky.

William R. Gorham, formerly directing engineer of the Tobatta Foundry Co., Tokyo, Japan, is now consulting engineer to the Nippon Industrial Co., Ltd., in Tokyo.

D. G. Roos, president of the Society and chief engineer, Studebaker Corp., was elected councilman at large for his county at the recent November elections, and

William S. James, Studebaker's research engineer, was elected councilman for his district.

F. M. Thomas, formerly aeronautical engineer in the research division, United Aircraft & Transport Corp., has joined the DeHavilland Aircraft Co., Ltd., Middlesex, England.

Charles H. Dolan is now aeronautical valuation engineer and special assistant to the solicitor of the Post Office Department, Washington, D. C.

Ernest A. Bell, formerly managing director, Commercial Vehicles Pty., Ltd., is now connected with Overseas Motors Pty., Ltd., Melbourne, Australia.

Walter F. Roeming has joined the Murphy Diesel Co., Ltd., as designer. He is located in Milwaukee.

L. H. Pomeroy, managing director, Daimler Co., Ltd., Coventry, England, has been

L. H. Pomeroy

inducted as president of the Institution of Automobile Engineers in England. Mr. Pomeroy's most recent visit to the United States was during the International Automotive Engineering Congress, sponsored by the S.A.E.

Cornelius T. Myers

Cornelius T. Myers, secretary and general manager of the Chassis Lubricating Co., died in Rahway, N. J., Oct. 24, as the result of a heart attack.

Mr. Myers was widely known in the automotive industry, and had taken a prominent part in the affairs of the Society after joining in 1911.

Beginning with a paper on "Chassis Design of the Class B Motor Truck," presented in the early post-War years, he gave generously to the Society of his broad knowledge in the field of motor-truck design.

His special interest for several years was the development of a system of magazine lubrication for the chassis of motor-vehicles. One of his first papers for the Society was on this subject, and his interest in it continued until the time of his death.

Other papers by Mr. Myers covered motor-truck subjects of a fundamental nature, but he found time also for competent excursions into other related fields.

Spontaneous tributes to the personality of the man have been received from many quarters of the Society's activity.

Deaths Reported

William C. Beelat, of Detroit, formerly supervisor of patterns, Continental Motors Corp.

John M. Williams, Jr., late assistant head of the research service division, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J., a member of the Society since 1920.

James W. Rawle, late vice-president, J. G. Brill Co., Philadelphia, an associate member of the Society since 1925.

Month Shows Rise in Applications

The list of applicants for membership of various grades in the Society (printed on page 36 of this issue of the JOURNAL) includes nearly 50 names, a figure which has not been reached in a single month for more than a year. In recent months, the number of applications printed in the issue of the Journal named has been as follows: November, 26; October, 16; and September, 21.

All of the applications represent new membership possibilities. Applications for reinstatement, which have been increasing, are not included in the figures.

Meetings Calendar

S.A.E. Tractor and Industrial Power Equipment Meeting

Hotel Stevens, Chicago, Ill., Dec. 5-6.

S.A.E. 30th Anniversary Dinner

(Annual Dinner) Commodore Hotel, New York, Jan. 7, 1935.

S.A.E. Annual Meeting

Including Engineering Display. Book-Cadillac Hotel, Detroit, Mich., Jan. 14-18, 1935.

S.A.E. Regional Meeting

Bond Hotel, Hartford, Conn., Dec. 14.

A Regional Meeting arranged for S.A.E. members and their friends in the Hartford area. Dinner 6:00 P.M., meeting 8:00 P.M.

Speakers—D. G. Roos, William B. Stout and John A. C. Warner. Inspection of Hartford plants available, if desired. You are invited.

Baltimore—Dec. 6

Engineers Club; dinner 6:30 P.M.

Motor Truck Development and Future Possibilities—Merrill C. Horine, sales promotion manager, International Motor Co.

Canadian—Dec. 9

Royal York Hotel, Toronto; dinner 7:00 P.M.

Chicago—Dec. 5

Stevens Hotel; 7:30 P.M.

Diesel Session of the S.A.E. Tractor and Industrial Power Equipment Meeting of the Society is being sponsored by the Chicago Section under the chairmanship of R. E. Wilkin. Hans Fischer of the Buda Co. will present a paper, "Diesel Application to Trucks, Tractors and Buses."

Cleveland—Dec. 10

Cleveland Club; dinner 6:30 P.M.

Piston Rings—Ralph R. Teetor, Perfect Circle Co.

Dayton—Dec. 11

Engineers Club; dinner 6:30 P.M.

Bearing Metals Brought Up to Date—Dr. C. H. Bierbaum, Lumen Bearing Co. Joint meeting with A.S.M.

Detroit—Dec. 3

Book-Cadillac Hotel; dinner 6:30 P.M.

Indiana—Dec. 13

Lafayette, Ind., at the plant of Ross Gear & Tool Co.

Brakes and Safety—A. E. Feragen, Bendix Brake Co.

Steering Gear and Safety—W. C. Creson, Ross Gear & Tool Co.

Plant inspection of Ross Gear & Tool Co. from 2:00 to 3:00 P. M.; welding conference at Purdue University, exhibits and demonstrations; dinner Purdue Union 6:00 P.M.

Kansas City—Dec. 7

Steuben Club; dinner 6:30 P.M.

Fuels and Lubricants.

Metropolitan—Dec. 10 and 27

Dec. 10—The Roger Smith, 40 E. 41st St., New York City; dinner 6:30 P.M. Aviation Meeting.

Dec. 27—Ladies' Night. A.W.A. Clubhouse, 353 West 57th St., New York City.

Milwaukee—Dec. 12

Milwaukee Athletic Club; dinner 6:45 P.M.

Superchargers — Herman E. Winkler, Chief Engineer, Schwitzer-Cummins Co.

New England—Dec. 11

Walker Memorial, Cambridge, Mass.; dinner 6:30 P.M.

Northern California—Dec. 4 and 14

Dec. 4—Athens Athletic Club, San Francisco; dinner 6:30 P.M.

Subject—Tires and Transportation.

Dec. 14—Annual Dinner and Dance, Whitcomb Hotel.

Northwest—Dec. 14

Seattle, Wash.

Fuel Injection—C. R. Alden.

Oregon—Dec. 14

Meeting and dinner at Refining Industries Co. plant in Portland; dinner 6:30 P.M.

Re-refining Lubricating Oils—S. C. Schwartz, vice-president and chemist, Refining Industries, Inc.

An Analysis of Safety Lane Inspection Data —J. Verne Savage, superintendent, City of Portland Shops.

Pittsburgh—Dec. 4

Pittsburgh Athletic Association; dinner 6:30 P.M.

Paper by Dr. W. A. Gruse, head of Petroleum Research, Mellon Institute.

Southern California—Dec. 7

Richfield Cafeteria Bldg., Los Angeles; dinner 6:30 P.M.

Copper Lead Bearings for Internal Combustion Engines—Bert L. Stone, chief engineer, Hydril Co.

Washington—Dec. 5

University Club, Washington, D. C.

Modern Military Mechanization — Major Harold A. Nisley, Ordnance Dept., U. S. A.

Modern Military Motorization—Col. F. B. Miller, Q. M. C.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Oct. 10, 1934, and Nov. 10, 1934.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Best, Frank Adam (A) manager, Backstay Welt Co. of Canada, Ltd., 813-819 Mercer Street, Windsor, Ontario, Canada.

Braner, S. W. (A) sales engineer, Victor Mfg. & Gasket Co., Chicago; (mail) 1052 South Mason Avenue.

Calkins, Louis A. (M) chief chemist, Valvoline Oil Co., Franklin, Pa.

Campbell, Wallace R. (A) president, treasurer, Ford Motor Co. of Canada, Ltd., East Windsor, Ontario, Canada.

Churchill, W. W. (A) superintendent of equipment, Washington Motor Coach System, 303 Central Terminal, Seattle, Wash.

Cole, Carter S. (M) engine assistant, Copper & Brass Research Association, Room 1326, 25 Broadway, New York City.

Coverley, Robert Henry (FM) experimental production engineer, Rolls Royce, Ltd., Derby, England; (mail) Glenroy, 205 Clarence Road.

Covert, M. B. (M) president, Renu Parts Corp., Holland, Mich.

Donham, Edward F. (M) supervisor, motor equipment, Illinois Bell Telephone Co., 208 West Washington Street, Chicago.

Edwards, C. J. (A) sales engineer, Ohio Rubber Co., Willoughby, Ohio; (mail) 525 Fisher Building, Detroit.

Evison, Samuel J. (A) salesman, Dole Valve Co., Chicago; (mail) 3-219 General Motors Building, Detroit.

Freeman, Walter R. (M) automotive engineer, Wagner Electric Corp., 6400 Plymouth Avenue, St. Louis, Mo.; (mail) 831 Westgate.

Gifford, Wearman Marston (A) general sales manager, Aluminum Co. of Canada, Ltd., 158 Sterling Road, Toronto 3. Ontario, Canada.

Hansen, George M. (J) mechanic, White Co., Buffalo, N. Y.; (mail) 100 Highland Avenue.

Harwood, Channing E. (M) manager, research, Russell Mfg. Co., Middletown, Conn.

Haskell, Raymond (M) industrial engineer, Texas Co., 135 East 42nd Street, New York City.

Healy, Francis P. (A) technical service supervisor, Van Norman Machine Tool Co., Springfield, Mass.

Herzig, Alvin John (M) chief metallurgist, Climax Molybdenum Co. of Michigan, 15 East Bethune Avenue, Detroit.

Hissin, G. N. (FM) Avtosavod, Gorky, American Village, House 14, U.S.S.R.

Huang, Pienchun (J) care of H. Tworoger, 57 Schillerstr. 57, Berlin-Charlottenburg, Germany.

Kynoch, Charles W. (M) research engineer, Dodge Bros. Corp., Division Chrysler Motors, Detroit.

Lamb, Ernest P. (M) assistant chief engineer, Dodge Bros. Corp., Division Chrysler Motors, 12800 Oakland Avenue, Highland Park, Mich.

Lane, John Woodbury (J) auto engineer, Standard Oil Co. of N. Y., Boston; (mail) 42 North Gate Park, West Newton, Mass.

Lundskow, Henry Peter (A) chief engineer, Peter Pirsch & Sons Co., Kenosha, Wis.; (mail) 2730 Washington Road.

Moffet, J. Donald (A) sales manager, Paul G. Hoffman Co., Inc., 907 West Seventh Street, Los Angeles; (mail) 1135 Concha Street, Altadena, Cal.

Mueller, Otto (M) research engineer, Murray Corp. of America, Frame Division, Ecorse, Mich.

Murray, H. Austin (J) automotive engineer, Texas Co., Statler Office Building, Boston; (mail) 145 Corey Street, West Roxbury, Mass.

Plasseraud, Rene (FM) Messrs. Weismann, Blum & Plasseraud, 84, rue d'Amsterdam, Paris, France.

Pollie, Hugh H. (M) superintendent of maintenance, Colonial Coach Lines, Ltd., 595 Little Sussex Street, Ottawa, Ontario, Canada.

Reid, Howard Edward (A) manager, Somerville Paper Boxes, Ltd., Walkerville, Ontario, Canada; (mail) 176 Walker Road.

Smith, Harry Dorsett (A) manager, Aro Equipment Corp., Room 502, 114 Liberty Street, New York City.

Sonkin, Jesse (A) office and advertising manager, Mott Haven Truck Parts, Inc., 429 Whitlock Ave., New York City; (mail) 215 West 92nd Street.

Whitted, Thomas B., Jr. (SM) First Lieutenant, United States Army, Fifth Field Artillery, Madison Barracks, N. Y.

Applications Received

The applications for membership received between Oct. 15, 1934, and Nov. 15, 1934, are listed herewith. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Adams, Austin Allen, airplane designer, Seversky Aircraft Co., Farmingdale, L. I., N. Y.

Ayers, Kenneth A., lubricating engineer, Standard Oil Co. of California, Portland, Oregon.

Barfod, Anker Lind, body draftsman, Fisher Body Corp., Detroit.

Barlow, Major Thomas Morgan, chief engineer, Fairey Aviation Co. Ltd., Hayes, Middlesex, England.

Beale, Stanley T., engineering instructor, Aeronautical University, Chicago.

Bierlein, Carl Andrew, apprentice, Winton Engine Corp., Cleveland.

Clendenen, John C., salesman, Standard Oil Co. of California, Seattle, Wash.

Coyle, Joseph L., 22 Stonleigh Circle, Watertown, Mass.

Craig, Robert S., 41 Roosevelt Road, Maplewood, N. J.

Dannemann, Henry F., proprietor, Highbridge Park Garage, New York City.

Daus, John P., Gunderman & Sons, Brooklyn, N. Y.

Durbin, John B., sales representative, General Motors Truck Co., New York City.

Ellis, Robert E., assistant manager, Aviation Department, Standard Oil Co. of New Jersey, New York City.

Engstrom, Carl, laboratory worker, United States Rubber Products Inc., Detroit.

Fick, A. L. J. M., governmental supervisor of public automotive transport, Wilhelminapark, 16, Breda, Holland.

Frailing, LeRoy Henry, test clerk, Packard Motor Car Co., Detroit.

George, Thomas Carl, junior aeronautical engineer, Naval Aircraft Factory, Philadelphia.

Kennedy, Maurice deKay Thompson, student engineer, Chrysler Corp., Detroit.

Keown, G. W., commercial engineer, Westinghouse Lamp Co., Bloomfield, N. J.

Klausmeier, Paul E., draftsman, Wright Field, Dayton, Ohio.

Koppen, Otto Carl, associate professor of aeronautics, Massachusetts Institute of Technology, Cambridge, Mass.

Kramer, C. Raymond, engineer, Chance Vought Corp., East Hartford, Conn.

Kudlich, Donald, observer, Wright Aeronautical Corp., Paterson, N. J.

Leonard, Alfred S., service manager, Sterling Motors Corp., Los Angeles, Cal.

Levine, Daniel M., engineer, Federal Engineering Co., Detroit.

Lindsay, George Edward, sales engineer, Exide Batteries of Canada Ltd., Toronto, Ont., Canada.

Liston, Joseph, assistant professor mechanical engineering, University of Oklahoma, Norman, Okla.

McMahan, Raymond Glen, power prover engineer, Cities Service Oil Co., Chicago.

Miller, Robert L., automotive safety engineer, Aetna Insurance Co., New York City.

Moore, Josiah C., Jr., automotive division, sales, Gulf Refining Co., Philadelphia.

Morrison, Malcolm C., automotive engineer, Dairymen's League Co-op Association Inc., New York City.

Mountjoy, Corydon H., president, Mountjoy Parts Co., Houston, Texas.

Oelschlager, W. R., general foreman, International Harvester Co., Milwaukee, Wis.

Peyton, J. A., president, American Gear and Parts Co. Ltd., San Francisco, Cal.

Pivarski, Samuel, detail draftsman, Fisher Body, Detroit Division, Engineering Plant No. 27, Detroit.

Potter, Raymond I., sales engineer, Standard Oil Co. of Ohio, Cleveland.

Reichardt, Otto A., foreman, Public Service Coordinated Transport, Newark, N. J.

Rice, J. Brooks, draftsman, Pacific Greyhound Lines, San Francisco, Cal.

Rosen, Harold, senior partner, American Grease Stick Co., Muskegon, Mich.

Sklovsky, Max, chief engineer, Deere & Co., Moline, Ill.

Sneed, Richard B., graduate laboratory assistant, Mechanical Engineering School, University of Oklahoma, Norman, Okla.

Stieglitz, William I., assistant to Mr. Smith, Bruce Smith, Aeronautical Engineer, Chicago.

Sureau, John Delany, general storekeeper, Third Avenue Railway Co., New York City.

Sutton, Philip G., general manager, Emich Motors Corp., Oak Park, Ill.

Trautman, Walter C., engineering student, Bruce Smith, Chicago.

Van Sinden, Carl H., commercial sales manager, General Tire & Rubber Co., Akron, Ohio.

Wentz, Chester L., lubrication sales engineer, Penola Inc., Detroit.

Wildhagen, F. G., national fleet sales, International Harvester Co., San Francisco.

Zenger, Herbert, manager, Stevens & Rathkey Co., Portland, Ore.

Zsuffa, Leslie F., cost accountant, United Parcel Service, New York City.

Notes and Reviews

THESE items, which are prepared by the Research Department, give brief descriptions of technical books and articles on automotive subjects. As a rule no attempt is made to give an exhaustive review, the purpose being to indicate what of special interest to the automotive industry has been published.

The letters and numbers in brackets following the titles classify the articles into the following divisions and subdivisions: *Divisions*—A, Aircraft; B, Body; C, Chassis Parts; D, Education; E, Engines; F, Highways; G, Material; H, Miscellaneous; I, Motorboat; J, Motorcoach; K, Motor-Truck; L, Passenger Car; M, Tractor. *Subdivisions*—1, Design and Research; 2, Maintenance and Service; 3, Miscellaneous; 4, Operation; 5, Production; 6, Sales.

AIRCRAFT

An Aerodynamic Analysis of the Autogiro Rotor with a Comparison Between Calculated and Experimental Results

By John B. Wheatley. N.A.C.A. Report No. 487, 1934; 17 pp., with tables and charts. Price, 5 cents. [A-1]

The Effects of Full-Span and Partial-Span Split Flaps on the Aerodynamic Characteristics of a Tapered Wing

By Carl J. Wenzinger. N.A.C.A. Technical Note No. 505, September, 1934; 6 pp., 9 figs. [A-1]

Experimental Verification of Theodorsen's Theoretical Jet-Boundary Correction Factors

By George Van Schliestett. N.A.C.A. Technical Note No. 506, October, 1934; 26 pp., 23 figs. [A-1]

The Effects of Equal-Pressure Fixed Slots on the Characteristics of a Clark Y Airfoil

By Albert Sherman and Thomas A. Harris. N.A.C.A. Technical Note. No. 507, October, 1934; 7 pp., 6 figs. [A-1]

Safety and Design in Airplane Construction

By Alfred Teichmann. Translated from *Automobiltechnische Zeitschrift*, Vol. 37, No. 2, January 25, 1934. N.A.C.A. Technical Memorandum No. 755, October, 1934; 12 pp., 1 fig. [A-1]

A Simple Method of Calculating the Induced Velocity of a Monoplane Wing

By Itirô Tani. Report No. 111 of the Aeronautical Research Institute, Tokyo Imperial University, August, 1934; 12 pp., with tables and charts. [A-1]

Motion of Stretched String in a Turbulent Flow of Air

By Daizo Nukiyama. Report No. 112 of the Aeronautical Research Institute, Tokyo Imperial University, September, 1934; 24 pp., with charts. [A-1]

The Fighting "Pterodactyl."

By C. M. Poulsen. Published in *Flight*, September 6, 1934, p. 914. [A-1]

Coupled with a wide speed range, the latest Westland machine has an exceptionally wide field of fire. According to the author, the new machine handles well on the ground and maneuvers well in the air.

Stipa Monoplane With Venture Fuselage

By Luigi Stipa. Translated from *Rivista Aeronautica*, Vol. IX, No. 7, July, 1933. N.A.C.A. Technical Memorandum No. 753, September, 1934; 8 pp., 25 figs. [A-1]

Contribution to the Mutual Interference of Wing and Propeller

By C. Wieselsberger. Translated from *Abhandlungen aus dem Aerodynamischen Institut an der Technischen Aachen*, No. 13, 1933. N.A.C.A. Technical Memorandum No. 754, September, 1934; 14 pp., 6 figs. [A-1]

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NOTES AND REVIEWS

Continued

CHASSIS PARTS

L'Eclairage des Projecteurs d'Automobile

Published in *La Technique Automobile et Aérienne,* Third Quarter, 1934, p. 77. [C-1]

This symposium on headlighting includes articles dealing with light distribution requirements; lamps molded with different patterns on the upper and lower sections for the suitable transmission of both driving and passing beam; lamps made of glass which absorbs ultraviolet, violet, indigo and blue light, transmitting the yellow, orange and red radiations; visual reactions following intense illumination of the eye and arguments in favor of the use of yellow light in headlighting.

Why Springs Have Their "Set" Removed

By Ferdinand Hintz. Published in *Machinery,* November, 1934, p. 164. [C-5]

In defining the term, "removing the set," Mr. Hintz explains that it is done by giving the spring an initial deformation, after the spring has been hardened and tempered. The effect is to raise the elastic limit of the spring beyond the value before the set is removed.

ENGINES

Interpretation of Exhaust Gas Analyses

By S. H. Graf, G. W. Gleeson and W. H. Paul. Bulletin Series, No. 4. Published by the Engineering Experiment Station, Oregon State Agricultural College, Corvallis, Oregon, May, 1934; 49 pp. [E-1]

A survey of the many recommendations contained in previous literature on this subject, the authors explain, makes it quite obvious that some of these have been made without the support of adequate test results; in other cases conclusions have been drawn or inferred when substantiating data were not presented; and in many instances the experimental data are incomplete or simplified.

The authors of the present bulletin have collected all available data, interpreting the correlations in the light of advanced practice as applied to gasoline or automotive engines, and indicating the practical significance of the results. The value of exhaust gas analyses is discussed and the applications of the information developed are pointed out.

Quill Bearings for Aircraft

By H. D. Allee. Published in *Aero Digest,* November, 1934, p. 30. [E-1]

Quill bearings, the author states, have the maximum carrying capacity possible for any given space and most of the 70 styles and sizes are made to fit specific requirements since the bearing is directly adaptable to locations in which an anti-friction bearing cannot be installed, or as a replacement for a bushing or plain bearing which will not carry its imposed load. These quill bearings are used mainly as loose rollers because in this manner they attain the maximum carrying capacity and occupy minimum space in the assembly in which they are used.

Heat Transfer from Finned Metal Cylinders in an Air Stream

By Arnold E. Biermann and Benjamin Pinkel. N.A.C.A. Report No. 488, 1934; 22 pp., illustrated. Price, 10 cents. [E-1]

Magnetic Pressure-Indicator for Internal-Combustion Engines

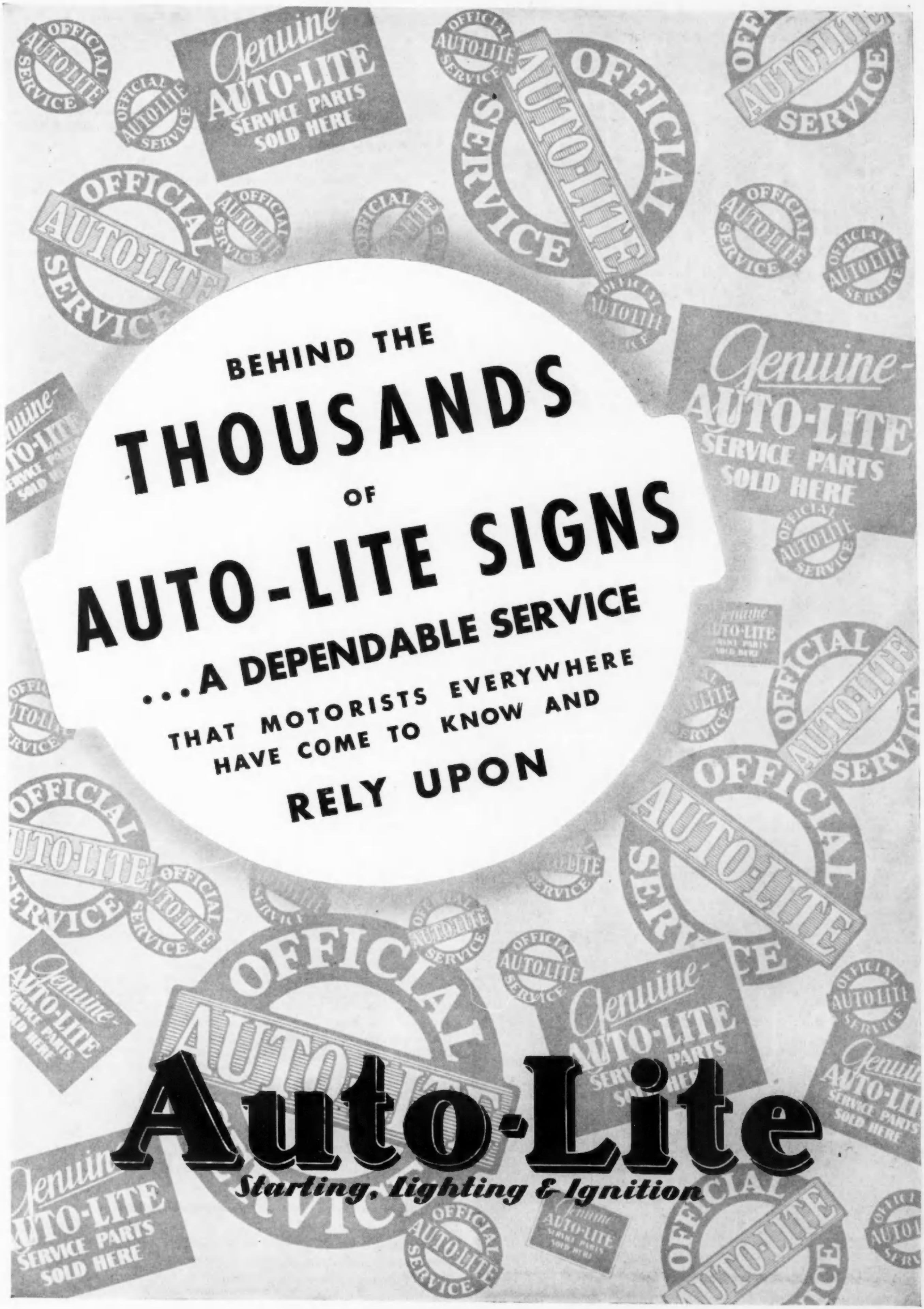
By Tatuo Kobayasi. Report No. 109 of the Aeronautical Research Institute, Tokyo Imperial University, July, 1934; 35 pp. [E-1]

Les Moteurs Diesel de Véhicules Automobiles

By J. Liné. Published in *La Technique Moderne,* Oct. 1, 1934, p. 640. [E-1]

The extension of Diesel engine use on commercial chassis has been considerable, the author points out in this first of a series of articles on the status of the automotive Diesel engine. In his opinion, the efficiency of the Diesel engine would give it the advantage of economy in operation, even were the cost of gas oil to be equal to that of gasoline. In the present article, he describes the Diesel engines at the Paris show, pointing out that practically all exhibitors equip at least some of their models with this type of power. In future articles he will give further details on the extent of Diesel engine use in France, Germany, England and Italy, and will point out the technical justification for such increased usage.

(Continued on page 42)


BEHIND THE
THOUSANDS
OF
AUTO-LITE SIGNS
...A DEPENDABLE SERVICE
THAT MOTORISTS EVERYWHERE
HAVE COME TO KNOW AND
RELY UPON
Auto-Lite
Starting, Lighting & Ignition
OFFICIAL AUTO-LITE SERVICE
Genuine AUTO-LITE SERVICE PARTS SOLD HERE

NOTES AND REVIEWS

Continued

MATERIAL

Knocking Characteristics of Hydrocarbons—Determined from Compression Ratios at Which Individual Compounds Begin to Knock under Specified Conditions

By Wheeler G. Lovell, John M. Campbell, and T. A. Boyd. Published in *Industrial and Engineering Chemistry,* October, 1934, p. 1105. [G-1]

This paper presents data on the knocking characteristics of 103 hydrocarbons, including paraffin, naphthene, and aromatic compounds. The measurements were made in the pure state and are expressed in terms of engine compression ratio at incipient knock under definite conditions of engine operation. Such critical compression ratios vary over a range of about fourteen ratios. The authors state that the qualitative general correlations between knocking characteristics and molecular structure previously found for such hydrocarbons when measured in dilute solutions hold in general, but there are some notable exceptions. These arise from the fact that the compression ratio of a mixture of two compounds is not always directly proportional to concentration.

Results of Engine Tests Using Motor Oils Manufactured by Solvent and Ordinary Methods

By Sidney Born and Earl Harper. Published in *The Oil and Gas Journal,* November 1, 1934, p. 12. [G-1]

A general comparison is made and the conclusions are reached that solvent oils are good or bad depending upon the kind of crude oil that is used in their manufacture and the particular solvent extraction process that is used. The authors contend that while it is unquestionably true that high-grade lubricating oils can be produced by solvent processes from low grade or naphthenic crudes, the actual engine tests do not bear out the supposition that these lubricants so produced are superior in actual service in an automobile engine to oils produced from high-grade paraffin base Mid-Continent crudes by the processes now in use.

Fuels and Lubricants for Internal Combustion Engines

By Prof. P. S. Paniutin. Published (in Russian) by the Gosmashmetisdat, Moscow and Leningrad, Russia, 1933; 272 pp., 46 figs., 98 tables. [G-1]

The twelve chapters of this book comprise lectures given to students of the Lomonosoff Institute during courses on the fuels and lubricants of internal combustion engines by Prof. Paniutin. The means of winning of these fuels and lubricants from naphtha, coal and other bituminous substances are dealt with thoroughly and the qualities of lubricating and fuel oils and their uses in internal combustion engines are treated.

The book is not intended for elementary reference since it assumes familiarity on the part of the reader with the fundamentals of chemistry, but rather for the engineer and designer who wishes to acquire a deeper knowledge of the subject.

Accelerated Tests of Nickel and Chromium Plating on Steel

By Paul W. C. Strausser, Abner Brenner, and William Blum. Published in the *Journal of Research of the National Bureau of Standards,* October, 1934, p. 519. [G-1]

Plated specimens similar to those used in atmospheric exposure tests were subjected to accelerated tests, especially by means of a salt spray and by intermittent immersion in a salt solution. The time required for the first appearance of slight rust in these tests was not consistent and had no direct relation to the protective value of the coatings. When the extent of rust at the end of a definite period, for example 100 hours, was recorded, the results were approximately parallel to those of atmospheric exposure. The protective value of a metallic coating of this type depends principally upon its freedom from porosity. The latter can be determined in a few minutes by the ferroxyl test.

1934 Supplement to Book of A.S.T.M. Standards

216 pp. [G-1]

A.S.T.M. Standards on Petroleum Products and Lubricants

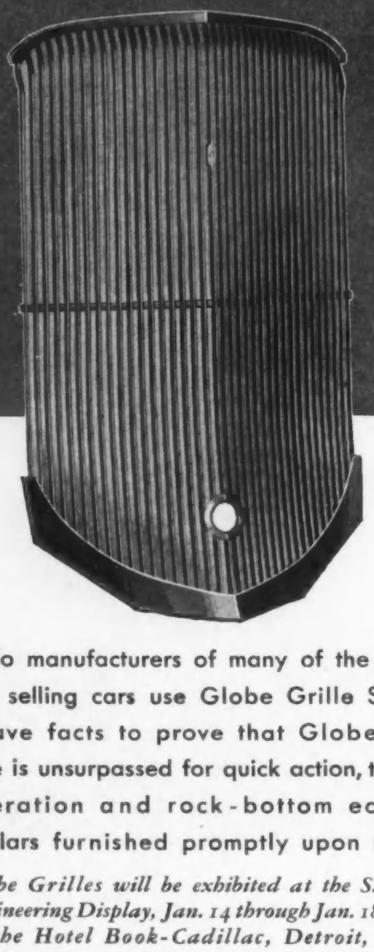
Prepared by Committee D-2 on Petroleum Products and Lubricants. 340 pp. [G-1]

The Significance of Tests of Petroleum Products

A Report Prepared by Committee D-2 on Petroleum Products and Lubricants. 76 pp. [G-1]

The above publications for the year 1934 have been made available by the American Society for Testing Materials, Philadelphia, Pa.

(Continued on page 44)



NOTES AND REVIEWS

Continued

Tests Show Merits of Butane as an Internal Combustion Engine Fuel

By C. J. Vogt. Published in *Automotive Industries*, Sept. 22, 1934, p. 348. [G-1]

Professor Vogt of the University of California concludes from his tests that if the higher compression ratios permissible with butane are employed, engine performance will be improved. Although thermal efficiency is less than with gasoline, this is offset by the lower cost of butane and by the fact that lighter oils may be used, thus reducing friction horsepower. He points out that no change in spark timing is necessary; slightly leaner mixtures than with gasoline should be used for best results; and with proper precautions, butane is as safe as other petroleum fuels and the carbon monoxide hazard is not as great.

Determination of Lead Soap in Oils and Greases

By Harry Levin. Published in *Industrial and Engineering Chemistry*, Analytical Edition, Sept. 15, 1934, p. 333. [G-1]

It is frequently necessary during the examination of greases, car oils, extreme pressure lubricants, and so forth, to determine the amount of lead soap present. Various methods have been published for this determination, but the author contends that most of them are inaccurate, difficult or tedious. The methods generally involve the determination of the combined lead present, from which, by suitable factors, the percentage of lead soap is calculated.

The more common methods for the determination of combined lead are outlined and the procedure, which has been developed in the author's laboratory, and which he states has proved universally satisfactory even in the hands of comparatively inexperienced operators, is described.

Measurement of Quality in Rubber Goods by Physical Tests

By Arthur W. Carpenter. Published in *Industrial and Engineering Chemistry*, Sept. 15, 1934, p. 301. [G-1]

Physical tests of rubber products may be classed in two groups—those which measure fundamental physical properties and those which determine service value. Performance tests of the latter class present many difficulties in their proper design and in the interpretation and correlation of the results. Often the value of a performance test is lost because of careless and incomplete mechanical analysis of the factors involved in the test and in the service of the article. Some of these factors are discussed and a number of performance tests are described. Data are presented showing the effect of the dual plastic and elastic nature of vulcanized rubber on the testing of indentation hardness. A time study is given of actual rate of stretching dumb-bell specimens in standard tensile testing.

The article is of special interest in connection with the testing of tires.

The Weathering of Aluminum Alloy Sheet Materials Used in Aircraft

By Willard Mutchler. N.A.C.A. Report No. 490, 1934; 35 pp., illustrated. Price, 15 cents. [G-1]

The Behavior Under Shearing Stress of Duralumin Strip With Round, Flanged Holes

By Karl Schüssler. Translated from *Luftfahrtforschung*, Vol. II, No. 3, August 18, 1934; Verlag von R. Oldenbourg, München und Berlin. N.A.C.A. Technical Memorandum No. 756, October, 1934; 22 pp., 1 table, 20 figs. [G-1]

Steels for Die-Casting Dies

By Sam Tour. Published in *Iron Age*, October 11, 1934, p. 22. [G-5]

The author lists characteristics necessary in die steels and indicates how the various available steels satisfy the requirements. Methods of testing die steels to fit the particular application are suggested. Proposed new alloys and their properties are mentioned.

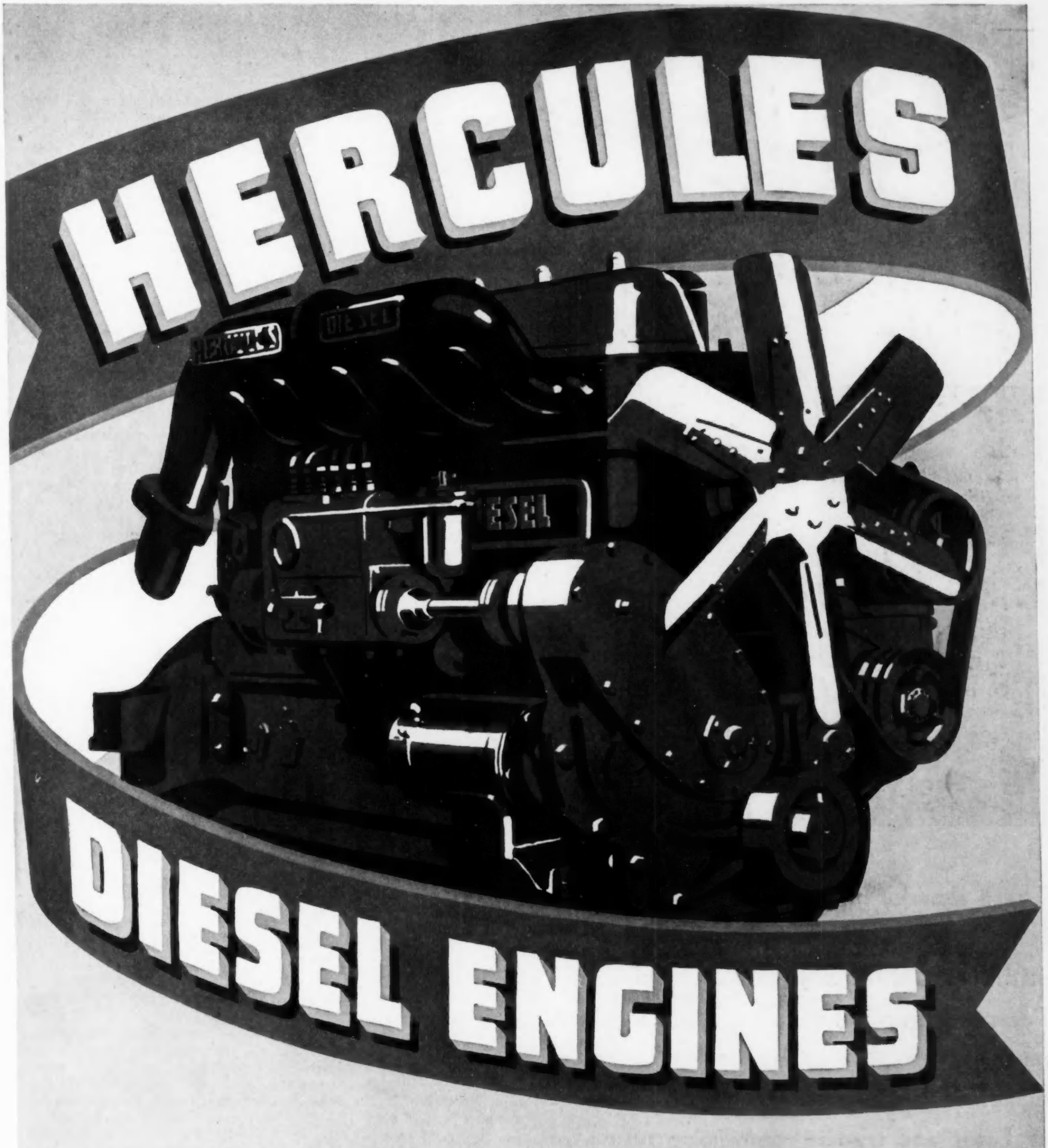
MISCELLANEOUS

Die Castings—Their Design, Composition, Application, Specification, Testing and Finishing

By Herbert Chase. Published by John Wiley & Sons, Inc., New York and London, 1934; 264 pp., illustrated. [H-1]

The author, who has been an active member of the Society for twenty-five years and therefore needs no introduction, states as his aim in the writing of this book to supply to engineers, product designers,

(Concluded on page 46)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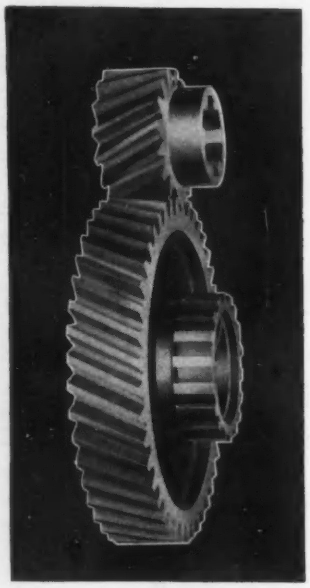

NOTES AND REVIEWS

Concluded

executives, students and others engaged or interested in the metal-working arts with the latest and best information available on die castings.

To this end, Mr. Chase has (a) presented material from which readers can form a better mental picture than they may have already of the commercial and technical possibilities of die castings; (b) set forth the characteristics of the various alloys suitable for die castings; (c) compiled such information as is needed for the intelligent design of die castings; (d) prepared facts useful in the specification, inspection and tests of die castings; and (e) furnished an outline of the types of finishes available for die castings, including useful particulars on the preparation of such castings for finishing and on the methods used in the finishing processes.

The book treats of the product rather than of the process and is addressed to users rather than to producers of die castings.

Nouvelles Méthodes de Mesures Mécaniques: Indicateurs de Pressions Moyennes, Torsiographes et Accélérographes

By Andre Labarthe. Published in *Journal de la Société des Ingénieurs de l'Automobile,* August-October, 1934, p. 2829. [H-1]

The author, who had previously developed a photo-cathode manograph, has applied the principles there involved in the design of other instruments here described. These are two integrating manographs, one giving by direct reading the mean ordinate of the pressure-time diagram, the other the mean indicated pressure; torsiographs measuring instantaneous and mean torsion and a recording accelerometer.

A brief resumé is given of the theory of such instruments and of previous types developed.

The Selection and Replacement of Manufacturing Equipment

By Paul T. Norton, Jr. Bulletin Vol. XXVII, No. 11 (Part I). Published by the Virginia Polytechnic Institute, Blacksburg, Va., September, 1934; 35 pp. [H-5]

The author points out that machine replacements almost invariably increase fixed charges, and unless the replacement study is made correctly, the increase in fixed charges may more than offset any decrease in operating expenses.

The real problem, then, is to determine just which machines can most profitably be replaced at any given time. This problem can be solved only by means of carefully prepared and basically sound replacement studies, Professor Norton contends, and sets forth in this bulletin an outline of a method for making such studies and illustrations of its use through actual examples.

Tolerances in Automotive Production

By P. M. Heldt. Published in *Automotive Industries,* October 20, 1934, p. 467. [H-5]

A summary of a comprehensive survey of tolerances in current American passenger cars, with general conclusions as to trends.

MOTOR-TRUCK

Les Véhicules Industriels et Commerciaux

By Jean Prévot. Published in *La Technique Moderne,* Oct. 1, 1934, p. 649. [K-1]

A wide range of sizes and forms is one of the chief characteristics of motor-truck development noted. Only large-scale producers are able to manufacture the great diversity in types required, and for this reason small builders are dropping out at a more rapid rate than in the passenger-car field. Besides suitability, economy both in fuel consumption and maintenance costs is a goal of current motor-truck design. In this article are reviewed the general features by which these two aims are achieved, and a second article will set forth details of the latest models of French manufacturers.

PASSENGER CAR

Tendances et Progrès de la Construction 1935

By Andre Caputo. Published in *Omnia,* October, 1934, p. 170. [L-1]

A magnificent exhibition, distinguished by novelties and technical triumphs, is the author's characterization of the 1935 Paris Salon. In his opinion, the feature of most intrinsic and permanent importance is the developments in transmissions. Independent front wheel suspension is establishing itself by virtue of its contribution to the solution of the steering problem. Streamlining has advanced from a fad of body design to a means for achieving greater economy and speed in automobile operation. Important also are said to be the expedients for achieving real riding comfort and silence.

As usual, in this show number of *Omnia,* the new models are described and summaries made of the progress achieved in various features of car design.

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